

1971

The Trade Gap in Latin America: the Theory of the Growth of the Foreign Trade Constrained Economy and a Test of Its Relevance to Latin America.

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71-29,381

McCain III, Roger Ashton, 1942-
THE TRADE GAP IN LATIN AMERICA: THE THEORY OF
THE GROWTH OF THE FOREIGN TRADE CONSTRAINED
ECONOMY AND A TEST OF ITS RELEVANCE TO LATIN
AMERICA.

The Louisiana State University and Agricultural
and Mechanical College, Ph.D., 1971
Economics, general

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THE TRADE GAP IN LATIN AMERICA:
THE THEORY OF THE GROWTH OF
THE FOREIGN TRADE CONSTRAINED ECONOMY
AND A TEST OF ITS RELEVANCE TO
LATIN AMERICA

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Economics

by

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May, 1971

ACKNOWLEDGMENT

The author wishes to acknowledge his debt to Dr. Robert A. Flammang and Dr. Herman E. Daly for their guidance, assistance, and patient encouragement; and to Dr. G. R. Rice, Dr. Roger Burford, Dr. David Johnson, and Dr. William Haag, for their insightful criticism and suggestions.

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ABSTRACT

In recent years, a number of studies of the growth of less developed countries have stressed the role of the capacity to import as a constraint of production and investment. Several studies stressed the relevance to Latin America, in particular, of the capacity to import constraint. This paper reviews the literature on economic growth subject to a trade constraint, explores some theoretical issues and policy questions arising from it, and finally subjects the theory to empirical test in the cases of eleven Latin American countries and Puerto Rico. It is found that the import limitation can arise independently of wrong policy choices whenever domestic capital goods can be substituted only within limits for imported capital goods. The import limitation may imply chronic trade imbalances among less developed countries (as well as chronic imbalances vis-a-vis developed countries). Thus, in schemes of trade integration, positive measures may be required to assure participation of all members in the gains from integration. In the empirical test, evidence was found in a majority of the cases that an imports constraint had been effective during the period studied. Only in the case of Chile was the evidence clearly to the contrary.

CHAPTER 1

INTRODUCTION

Several years ago it was widely accepted that the fundamental cause of underdevelopment was a shortage of capital. The well-known paper of Eckaus¹ can serve as a convenient case in point. It argued that even with minimally capital-intensive techniques, underdeveloped countries had not enough capital to employ their entire populations, and that the overt or hidden unemployment which resulted from this shortage, together with the intrinsically rather unproductive nature of minimally capital-intensive techniques, accounted for the low incomes per capita under which the underdeveloped countries suffered. Thus underdevelopment was in essence a factor problem, or, more precisely, a problem of factor imbalance. Labor was in excess relative to capital; and conversely capital was inadequate relative to labor. This led to an emphasis on securing large increases in the capital stock while limiting population growth.² A troublesome question was why massive inflows of capital had not occurred in the past, so as to rectify this capital imbalance. Two answers were presented: first, due to demand-supply interactions, indivisibilities,

¹R. S. Eckaus, "Factor Proportions in Underdeveloped Countries," American Economic Review, XLV, 4 (Sept. 1955), pp. 539-565.

²See R. A. McCain, "The Theory of Economic-Demographic Development in the Transition from the Underdeveloped to the Developed State: a Survey," Unpublished master's thesis, LSU, 1966, for a survey of population-growth-centered studies.

and other related external benefits of investment, the marginal private product of investment was quite low, even though the marginal social product of investment was quite high. Thus "balanced growth" and a "big push" were required for development, and these could not occur without guidance and external aid.³ Second, underdeveloped countries could expect rapid increases in population which would keep the income per capita low unless the overall rate of growth was quite high. However, a low rate of saving would result from low incomes per capita, since those incomes would in some sense approximate subsistence. In the Harrod-Domar framework, low saving rates would mean low rates of growth. One may add that the Harrod-Domar framework would seem appropriate to a country which is by assumption using the minimally capital-intensive techniques, since no substitution of labor for capital would be possible, and none of capital for labor desirable in the near future. Thus, the circular causation of low incomes resulting in low saving resulting in low incomes constitutes a Malthusian trap⁴ from which the underdeveloped countries can escape only by a "big push," which will require external assistance.

This view has been pretty largely abandoned.⁵ A primary

³P. Rosenstein-Rodan, "Problems of the Industrialization of Eastern and Southeastern Europe," Economic Journal, LIII, 2 (June-Sept. 1943), pp. 202-211; and R. Nurkse, Problems of Capital Formation in Underdeveloped Countries (Oxford: Oxford University Press, 1953) were statements of the "balanced growth" doctrine.

⁴R. A. McCain, op. cit., surveys this. H. Leibenstein, The Theory of Economic-Demographic Development (Princeton, N.J.: Princeton University Press, 1954) is an important early survey.

⁵This is not to say that capital-centered theories of economic development are unheard of today. See L. J. Junker, "Capital Accumulation, Savings-Centered Theory and Economic Development," Journal of Economic Issues, I, 1-2 (June 1967), pp. 25-34 for a survey. However, capital does not seem to hold the field as it once did.

reason seems to be the accumulating evidence that underdeveloped countries were not making full use of domestic savings potential.⁶ Further, foreign assistance had produced few dramatic successes, and the few (Taiwan, Israel,⁷ and Greece⁸ may be cited) were special cases in several senses: they had received especially large amounts due to ideological or military-strategic or religious special relationships with developed countries, they were situated geographically on the boundaries of the underdeveloped world, and it could at least be argued that the cultural obstacles to economic growth were less important in their cases than in others. Any one of these elements, or all of them, might explain their relative success. Second, it became apparent that countries with unlimited supplies of foreign capital could still be underdeveloped. The petroleum sheikhdoms offer clear examples, but Libya⁹ with its somewhat greater population, seems an even more convincing one. There is evidently a limit to the extent to which a country can absorb capital, and external capital in particular. This limit may stem from the lack of a labor force with appropriate skills, limits to the diffusion of information about new investment opportunities, limited entrepreneurial activity,

⁶ See A. O. Hirschman, The Strategy of Economic Development (New Haven: Yale University Press, 1958), p. 37. Linder attempts an estimate of frustrated saving in Latin America in Trade and Trade Policy for Development (New York: Praeger, 1967), p. 66.

⁷ H. Chenery and M. Bruno, "Development Alternatives in an Open Economy, the Case of Israel," Economic Journal, LXXII, 1 (March 1962), pp. 79-103.

⁸ Adelman and Chenery, "Foreign Aid and Economic Development: The Case of Greece," Review of Economics and Statistics, XLVIII, 1 (Feb. 1966), pp. 1-19.

⁹ See B. Higgins, Economic Development Rev. Ed. Ch. 35. (New York: Norton, 1968).

and, in the case of external capital, limited supplies of goods complementary to external capital, which must for some reason be produced within the country (labor skills might be a special case of this category). If these domestic constraints are effective, then neither foreign nor domestic capital can contribute to a higher rate of growth. In that case resources (including the efforts of economic theorists, no doubt) should be devoted to raising or removing the various limits to the capacity to absorb capital.

This shift of emphasis has led economists to locate the fundamental developmental problem in one of two areas: either outside economics completely, or in one of those aspects of economic behavior which is less susceptible to traditional economic analysis than is the accumulation of capital. Sociocultural elements, especially those related to entrepreneurial activity, have been stressed by some theorists.¹⁰ The generation of technology appropriate to the factor-proportions of underdeveloped countries has been stressed by others.¹¹ Unfortunately, while some persuasive hypotheses have been posed, the exploration of these important aspects of economic development would seem to be still in its infancy.

Some economists, concerned more with the development of policy

¹⁰E. E. Hagen, The Theory of Social Change (Homewood, Ill: Irwin, 1962), is a case in point.

¹¹H. Bruton, Principles of Development Economics (Englewood Cliffs, N.J.: Prentice-Hall, 1965), Ch. 11, presents a rather pessimistic view; Atkinson and Stiglitz, in "A New View of Technological Change," Economic Journal, LXXIX, 4(1969), 573, argue that progress in developed countries will be of no help to underdeveloped countries.

than of theory, have adopted a less aggregative perspective.¹² They have found some evidence that the limit of absorptive capacity, although real, is not reached in some countries because they cannot grow fast enough to reach it, for other reasons. The limit to growth in such countries may stem from either an inadequate rate of saving, or a chronic balance-of-payments problem which limits import inputs necessary for growth. Thus the body of theory which has grown up around these policy studies is often called two-gap theory. The cause of the chronic balance-of-payments problem hypothesized by the two-gap theorists is still controversial, but one study¹³ suggests that it is a factor-imbalance problem: a shortage of imported capital goods relative to capital goods which the country is capable of producing for itself. Here we have another case of circular causation, then, since the chronic balance-of-payments problem perpetuates the shortage of imported capital goods. This body of literature is reviewed in Chapter Two, so all that needs be observed here is that it would make underdevelopment essentially a factor problem, in some cases at least. This might be seen as a new sort of capital-centered theory, centered, that is, about a disaggregated notion of capital.

In fact, there is no very obvious reason to suppose that all underdeveloped countries are underdeveloped for the same reasons. Thus it may be that some underdeveloped countries do indeed face an

¹²Chenery and his collaborators, op. cit., and H. Chenery and A. Strout, "Foreign Assistance and Economic Development, American Economic Review, LVI (1966), pp. 679-733.

¹³Linder, op. cit.

imbalance of imported as against domestic capital goods, while in others the problem is indeed a low rate of absorption of capital, and in still others, a population trap may prevail or problems relating to external economies may inhibit growth. Much as a simple, general theory of underdevelopment would be attractive, it is possible that underdevelopment is not a simple, general phenomenon and that such a theory would merely be misleading.

The purpose of this study is to examine the "two-gap" or import-constrained growth hypothesis in a Latin American context.¹⁴ Part One, consisting of Chapters Two through Five, is concerned with the two-gap theory and policy conclusions which may be drawn from it. Chapter Two reviews the literature on the hypothesis, a literature which is evidently in the process of rapid growth. Chapter Three restates the theory. Chapter Three is presented for the convenience of the reader, and its content is primarily expository. Chapter Four examines a troublesome theoretical point in two-gap theory and argues that a trade constraint can arise "as a necessary and endemic consequence of the developmental process."¹⁵ Chapter Five is concerned with the implications of two-gap theory for the integration of

¹⁴Reference is to Linder, op. cit. Two studies of Argentina ought to be cited. F. Masson and J. Theberge, "External Capital Requirements and Economic Development," Journal of the Royal Statistical Society, Series A, CXXX,3(1967), pp. 378-407, and O. Braun, and L. Joy, "A Model of Economic Stagnation--A Case Study of the Argentine Economy," Economic Journal, LXXVIII, 4(Dec. 1968), pp. 866-887, come independently to the conclusion that Argentina's economy is trade-constrained.

¹⁵The phrase is due to Bruton, "The Two-Gap Approach to Aid and Development," American Economic Review, LIX, 3(June 1969), pp. 443-446.

international trade among underdeveloped countries. This study does not deal with other aspects of trade policy or with issues of fiscal policy or developmental planning, since the implications of the imports constraint for these areas has already been extensively investigated.¹⁶ Part Two, comprising Chapters Six through Eight, is a comparative study of the implications of time series data with respect to the truth or falsity of the two-gap hypothesis in eleven Latin American countries and Puerto Rico. Chapter Six introduces the section and considers the methods used. Chapter Seven reports the results of the statistical study. Chapter Eight suggests a topic for further study. Chapter Nine summarizes and concludes this paper.

¹⁶These topics are reviewed in Chapter Two.

CHAPTER 2

A REVIEW OF THE LITERATURE ON THE IMPORTS-CONSTRAINED GROWTH OR "TWO-GAP" HYPOTHESIS

The imports-constrained growth hypothesis states that investment and growth in an underdeveloped country are constrained the country's capacity to import. Other constraints may be assumed as well, and since the potential constraint of the capacity to save is an obvious choice, the theory is sometimes called¹ the "two-gap" hypothesis, referring to the fact that maximum growth may require the bridging of two gaps: one between needed and available finance, and one between needed and available imports. It is a hypothesis which appeared relatively recently, so the literature is fairly sparse and is limited to the sixties. Its emergence has been to some extent associated with the research of the United Nations Conference on Trade and Development.² The work of Hollis Chenery and his

¹H. Chenery and A. Strout, "Foreign Assistance and Economic Development," American Economic Review, LVI, 4 (Sept. 1966), pp. 679-733. H. Chenery and A. Strout, Foreign Assistance and Economic Development, AID Discussion Paper 7, June, 1965.

²See e.g., R. Diwan, "A Test of the Two Gap Theory of Development," Journal of Development Studies, IV, 4 (July 1968), pp. 529-537, a study supported by UNCTAD, and D. Wall, "Import Capacity, Imports and Economic Growth," Economica, N.S., XXXV (May 1968), pp. 157-168.

collaborators has been an important contribution,³ as has Staffan Linder's book,⁴ a work which concentrates on Latin America. This chapter reviews that literature. Section One considers the partial statement of Prebisch⁵ and the work of Chenery and others. Section Two reviews the contributions of McKinnon⁶ and Diwan,⁷ and, for contrast, the classical theory of Baldwin.⁸ Section Three reviews Linder's book. Section Four reviews the recent critiques of two-gap theory by Bruton⁹ and Nelson,¹⁰ and considers the study of Slater.¹¹

³H. Chenery and A. Strout, op. cit., 1965, 1966; Chenery and Bruno, "Development Alternatives in an Open Economy; the Case of Israel," Economic Journal, LXXII, 1, (March 1962), pp. 79-103; Chenery and McEwan, "Optimal Patterns of Growth and Aid; the Case of Pakistan," Pakistan Development Review, Summer, 1966; Adelman and Chenery, "Foreign Aid and Economic Development: The Case of Greece," Review of Economics and Statistics, XLVIII, 1 (Feb. 1966), pp. 1-19; Bruno, "Optimal Patterns of Trade and Development," Review of Economics and Statistics, XLIX, 4 (Nov. 1967).

⁴S. Linder, Trade and Trade Policy for Development (New York: Praeger, 1967).

⁵R. Prebisch, Toward a Dynamic Development Policy for Latin America (United Nations E/CN.12/680/Rev.1, sales no. 64, II.G,4), p.70.

⁶R. McKinnon, "Foreign Exchange Constraints in Economic Development and Efficient Aid Allocation," Economic Journal, LXXIV, 2, (June 1964), pp. 389-409.

⁷Op. cit.

⁸R. Baldwin, "The Role of Capital-Goods in the Theory of International Trade," American Economics Review, LVI, 4 (Sept. 1966), pp. 891-898.

⁹H. Bruton, "The Two-Gap Approach to Aid and Development Once Again," American Economic Review, LIX, 3 (June 1969), pp. 439-446.

¹⁰R. Nelson, "The Effective Exchange Rate: Employment and Growth in a Foreign Exchange-Constrained Economy," Journal of Political Economy, LXXVII, 3 (May-June 1970), pp. 546-64.

¹¹C. Slater, "External Debt and Economic Development: Some Empirical Tests of Macroeconomic Approaches," Southern Economic Journal, XXXVI, 3 (Jan. 1970), pp. 252-62.

I: The Emergence of Two-Gap Theory

There have, of course, been hints of the kind of hypothesis set out here prior to its systematic development. One might cite Prebisch,¹² writing in 1961-62. Although he was primarily pointing out the effects of the terms of trade on the development of those countries which export chiefly primary products, he notes that

Today, however, the external bottleneck...is much more difficult to eliminate.

This is due not only to the complexity and cost of the items now involved in the substitution process but also to the fact that the reducible margin of imports has disappeared or has been reduced to a negligible proportion. [emphasis added]. As long as there was an ample margin of imports which could be dispensed with, in the immediate future, or deferred, the expansion of some imports could for the moment be held up or their volume restricted, while substitution was being effected in respect of other items. Imports of essential or urgently-needed goods could thus steadily increase without affecting the tempo of economic activity. But once this margin narrows or disappears altogether, this procedure cannot be repeated, particularly when the flow of exports is reduced or their volume is contracted, while demand for such imports continues to grow. In these circumstances, external disequilibrium--and a pressing need for international resources--is the only alternative to a slowing-up or definite contraction of the rate of economic activity.

Moreover, with regard to debt services,¹³

A more and more serious incompatibility between services and imports thus arises, and is frequently aggravated by the shortness of loan maturity periods, which entails excessively heavy amortization payments. And as imports cannot easily be reduced, the only way out is to obtain further international resources to defray service payments, even when such contributions are not absolutely essential to fill the gaps in external capital formation.

¹²Op. cit.

¹³Op. cit.

The imports-constrained model is present in Prebisch's pamphlet, although below the surface of formal presentation, as these quotations should suffice to show. There is an irreducible minimum of imports necessary for full employment and maximal growth, and the minimum of imports unrelated to capital formation has to be distinguished from "external capital formation." Together, however, the needs for both are more than the countries' deteriorating trade positions can supply. Moreover, this contradiction grows stronger with passing time and on-going development.

This should not be surprising. Prebisch wrote in the context of postulated deterioration in the gross barter terms of trade of the Latin American countries. A deterioration of the gross barter terms of trade may actually have no adverse effect if, for example, it is more than offset by increasing productivity. Even if it is not, however, it needs a priori have no effect on the country's aggregate employment either in static terms or in growth terms. The substitution of domestic produce for imported produce should allow the country to continue at full aggregate capacity, despite a decreasing capacity to import, unless there is an irreducible minimum of imports. The substitution of domestically produced capital goods for imported ones should allow growth to go on with minimal loss, unless there is a limit to such substitution. The logic of Prebisch's primary production and deteriorating terms of trade points to imports-limited growth. This is most probably more than an accidental correspondence, given Prebisch's and the "two-gap" theory's association with UNCTAD.

However, the first explicit statement of the theory seems to be

that of Chenery and Bruno.¹⁴ On the basis of that beginning, Chenery¹⁵ and others have developed an approach to imports-constrained growth theory which is highly policy-oriented and which they have used directly in mathematical programming methods of optimum planning. The direct policy orientation of their work has had to some extent a formative influence on their work, although it shares some characteristics with such theory-oriented writers as McKinnon,¹⁶ Linder,¹⁷ and somewhat less with Diwan.¹⁸ This essentially exhausts the literature on the imports-constrained growth theory, except for a recent critique by Bruton and hence the remainder of this section will be a review of these contributions in essentially the order mentioned.

Chenery and Bruno's article focused on an attempt to set out the feasible development alternatives open to Israel.¹⁹ They expected that the objectives of a development plan for Israel would be maximum income and full employment, the instruments tax policy, trade policy, investment allocation and capital imports, and the limitations composition of demand, balance of payments, labor supply, and capital supply. The items emphasized give a clue to the role of the use of the imports-constrained growth model in the paper. Balance of payments, is, indeed, a limitation on the activity of the economy, but is it one that is

¹⁴Op. cit.

¹⁵See note 3, above, p. 9.

¹⁶Op. cit.

¹⁷Op. cit.

¹⁸Op. cit.

¹⁹Op. cit., p. 79.

relevant in a growth-oriented study? And if the level of capital importation is sufficiently under the country's control to be an instrument of policy, is the balance of payments a limitation after all? In fact, their treatment of foreign capital inflows is a bit more complex. It plays three roles in the programming model: as an instrument of policy, as an objective variable in the sense that the country is assumed to be striving for eventual self-sufficiency, and as a variable subject to autonomous institutional limits.

But what of the relevance of the capital inflow to growth? It has two roles, corresponding to the "two gaps": it is a source of capital and of imports. A shortage of either capital or imports may limit growth.

It has been argued above that there is a third general limitation to growth on a par with the two considered by Harrod: the balance of payments. As a policy problem, the balance-of-payments limitation is quite similar to the savings-investment limitation. An increase in the rate of growth often requires a change of the structure of income used in order to reduce the proportion going to consumption and hence increase savings. It may also require a change in the structure of production in order to reduce the ratio of imports to total output. It is not clear a priori, either in Israel or in other countries, which of these structural relations is more likely to limit growth or which is harder to change.²⁰

However, there is a bit more to be said. Modern economic growth theory²¹ does not assume that capital and output are linearly related, and the assumption is usually made that the production function embodies the possibility of substitution of capital for labor, or

²⁰ Ibid., p. 85.

²¹ R. Solow, "A Contribution to the Theory of Economic Growth," Quarterly Journal of Economics, LXX, 1 (Feb., 1956), pp. 65-94.

vice versa. Why should not the role of imports in production display a similar flexibility? Chenery and Bruno write:

Although the Harrod-Domar model has been criticised for its omissions of substitution between labour and capital, it is generally recognized that such substitution can only take place over a period of time and depends to a large extent on the installation of new equipment. We shall therefore treat the labour-capital ratio as a function of time, but shall assume both inputs are in fixed proportions at any moment. For simplicity, a trend will be associated only with the labor input, which is consistent with the past decade.²²

(Actually, the output-capital ratio declined at an average rate of 2.8% per annum from 1950-1959-60 and by a constant rate of 2.7% per annum from 1955-1959-60, according to the data presented by Chenery and Bruno.²³)

It may indeed be plausible that the input proportions display some inertia so that they would be approximately constant over the short run. However, that is not necessarily to the point. To illustrate the issue, suppose that a planned economy faces the prospect of unemployment in the coming plan period because it cannot invest enough to employ the entire increase in the effective labor force, using techniques currently in use. If there are available techniques which are less capital intensive and more labor intensive, clearly the entire labor force can be employed during the coming plan period by allocating the available capital to labor-intensive activities. It is true that the overall capital-output and capital-labor ratios will be unchanged over the short run, since within the short run capital formation is insignificant relative to the volume of existing plant.

²²Chenery and Bruno, op. cit., p. 86.

²³Ibid., p. 81, Table I.

However, the marginal capital-output and capital-labor ratios will be wholly different from their former values (and from the corresponding overall ratios) and this implies a very different growth path for the economy. Moreover, the "planned economy" assumption may be relaxed, as the same will occur in a theoretical perfect market system (in which all markets clear in the short run, including the labor market). In that case the quasirents on existing plant bear the cost of the adjustment. Whether it will occur in a market system with imperfect foresight depends upon investors' expectations with regard to the future course of factor prices.

Moreover, the assumption of fixed proportions leads Chenery and Bruno into other difficulties, since a change in the composition of output will have an effect on the capital output ratio even when the capital output ratio is given in each sector.

More important than direct substitution between labor and capital is the effect of a change in the composition of output on capital requirements....Any substantial departure from the assumed composition of the increase in output will therefore require a recalculation of [the incremental output capital ratio].²⁴

The same is true of the ratio of output to imports. Indeed, the relationship between outputs and imports is written on a sectorally-disaggregated basis.

However, the assumption of strictly fixed proportions of consumption is even more implausible, prima facie, than fixed proportions of production. Why should there not be a product intensive in domestic factors which is a good substitute in use for one intensive in imported goods? If imports are becoming progressively more scarce, will not the

²⁴Ibid., p. 87.

price of the latter rise in such a way as to induce the substitution of the former?

Chenery and Bruno then proceed to use the model, with estimates for the parameters, to obtain four equations in gross national product, unemployment, rate of growth of labor productivity, the marginal savings rate, foreign capital inflow, private consumption and government expenditure. A "feasible program" is then defined as one which satisfies the four equations and in which no controlled variable falls outside a predetermined range. The predetermined ranges are based on political and administrative considerations and on some economic effects which are beyond the range of explicit consideration in the model. The controlled variables include the ones mentioned above and the effective exchange rate. Labor productivity is considered as a controlled variable, although it is not actually under the country's control, because it was judged necessary to consider the implications of several rates of improvement for the economy. Full employment and government expenditure were considered as fixed objectives of the government and hence only one level was assumed for each of them. Ten feasible programs were calculated. Figures one, two and three (after Chenery and Bruno²⁵) show the feasible regions with respect to gross national product and the marginal rate of saving, s ; and the level of exports, E ; and the level of foreign capital inflow. The lines labelled ℓ_a , ℓ_b , ℓ_c represent the various assumptions as to the rate of increase of labor productivity, combined with the rate of increase of the labor force, some allowance evidently being made for variation of

²⁵Ibid., pp. 95-96.

the latter. (Chenery and Bruno are not clear on this point.²⁶) The overall conclusion of this analysis is that "In Israel at the present time, therefore, the balance of payments seems as likely to determine the rate of growth as the savings-investment limit."²⁷

Chenery and Bruno next broaden their analysis by further disaggregation and the use of a twenty-sector input-output table. This points up the fact that movements of resources specified in the more aggregative model may actually be more massive and difficult than it would seem to indicate, since they actually take place among more highly specified sectors. "For example, if instead of saying that under solution 7 above, 38% of the increase in output must take place in export sectors, we say that exports of manufactured goods must triple in five years, the specific nature of the resource shift becomes clearer."²⁸ In particular, all of the feasible programs are likely to

require a substantial shift of resources from agriculture and services to mining and manufacturing. This change in the composition of output is necessitated by limited domestic and foreign demand for agricultural products, the required reduction in the import surplus, and the consequent need to expand the production of minerals and manufactured goods, particularly those that substitute for imports or can be exported.²⁹

Chenery and Bruno then introduce formal welfare analysis to attempt to indicate the optimum program. Consumption (public and private), the capital stock, and foreign borrowing are regarded as the

²⁶ Ibid., pp. 94-95.

²⁷ Ibid., p. 97.

²⁸ Ibid., p. 97.

²⁹ Ibid., p. 98.

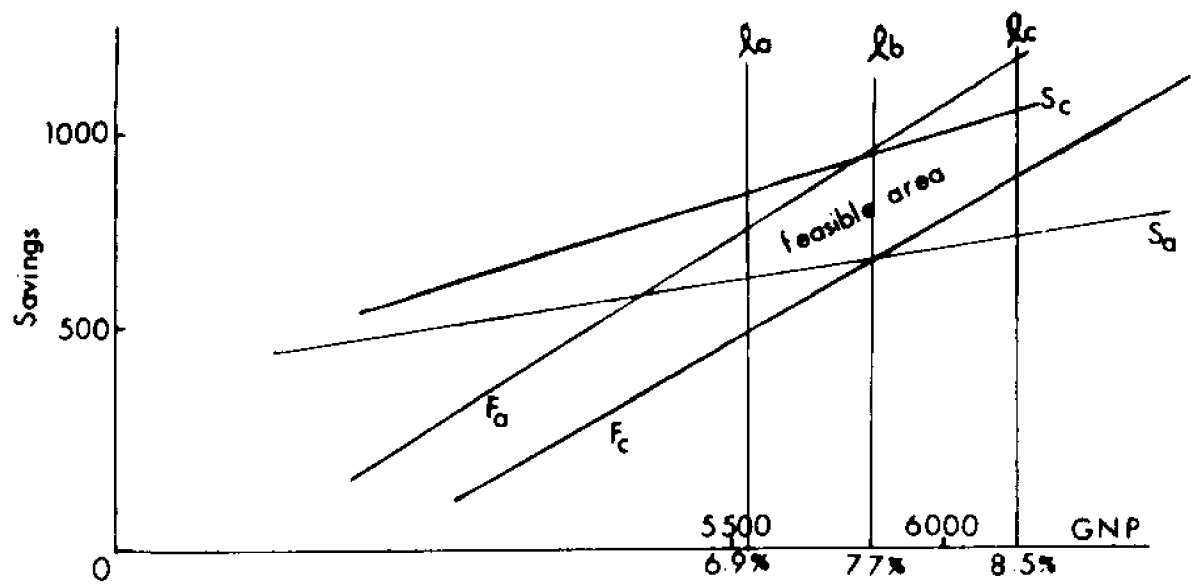


Figure 1

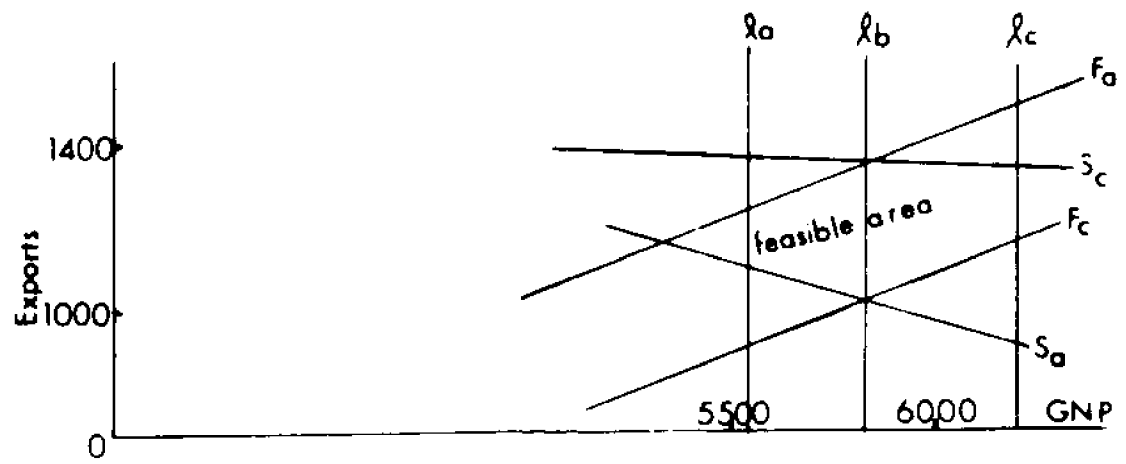


Figure 2

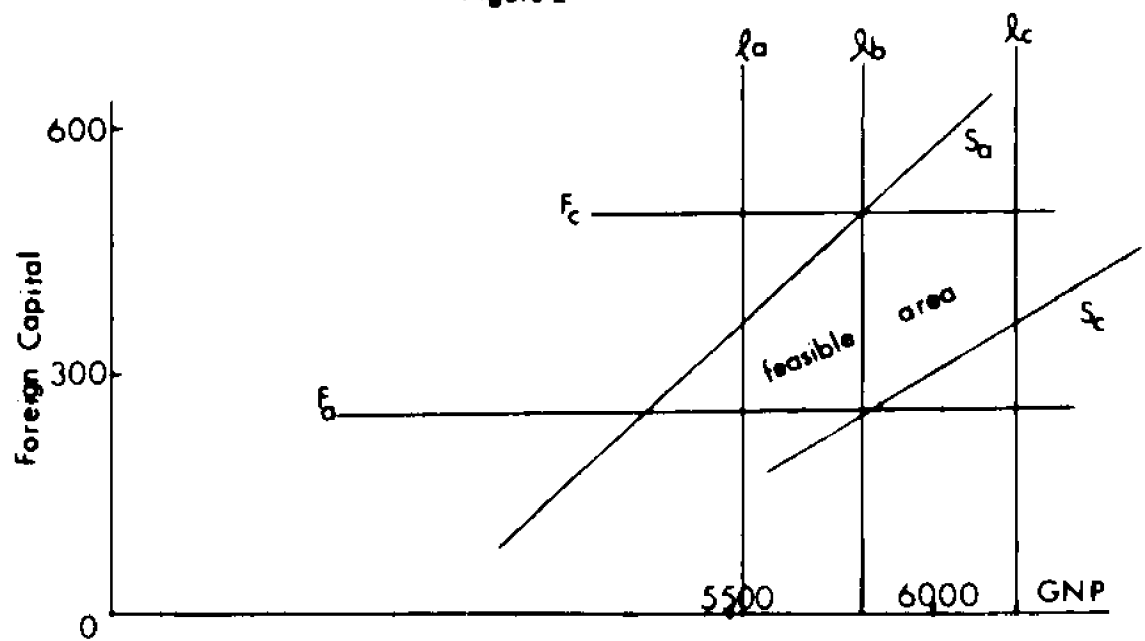


Figure 3

determinants of welfare. However, they immediately simplify by deleting the capital stock and comment that

Taking consumption over time as the measure of welfare, we can (in principle) measure the welfare loss due to an increase in foreign borrowing as the sum of interest costs, the effects of reduced future borrowing power, and the loss of future consumption due to the need to develop an export surplus. These elements suggest an increase in the unit cost of borrowing to the economy as F [the foreign capital inflow] increases.³⁰

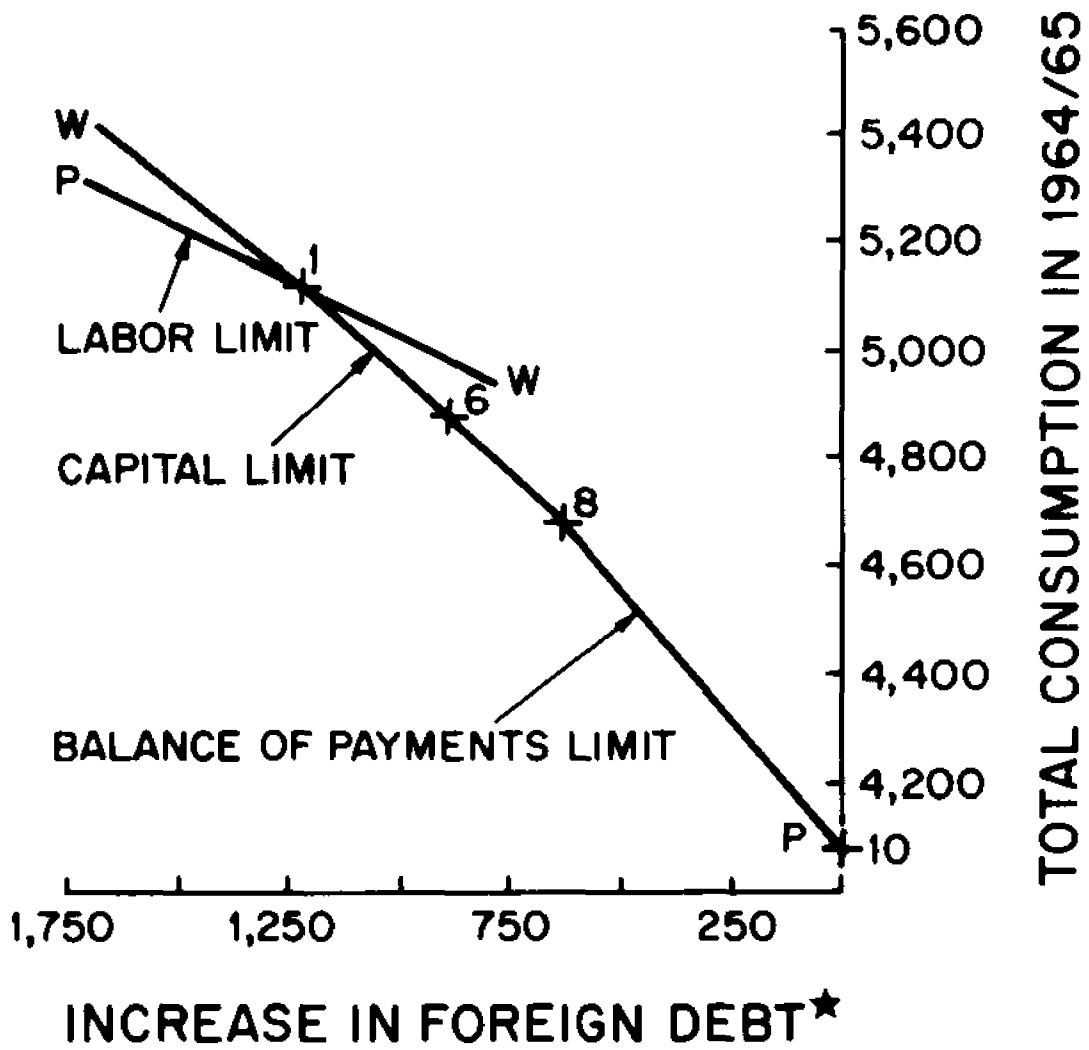
Moreover, if all other controlled variables are given, it is possible to draw the production possibilities curve of the Israeli economy in terms of foreign borrowing as in Figure Four (after Chenery and Bruno). Giving unsystematic consideration to the determinants of the cost of foreign borrowing mentioned above, they conclude that the optimum program lies between points one and eight, and probably between points one and six.

Finally, Chenery and Bruno develop formulae for the productivity of foreign assistance. "We define the marginal productivity of foreign aid as the increase in GNP in year n (dV_n) that is achievable from a unit increase in external resources distributed over the plan period,"³¹ and "with plausible values of the parameters, the productivity of aid will range from 0.2 to 0.6 or so when domestic savings are the limit to growth and from 0.4 to 1.0 or over when the balance of payments is the limiting factor. Low productivity is associated with high capital-output ratios, low savings, and high import propensities."³² For Israel, they estimate the productivity of aid as

³⁰ Ibid., p. 100.

³¹ Ibid., p. 101.

³² Ibid., p. 102.



*Total increase in foreign debt = 2.5 Fn.

between 0.85 and 1.10 depending upon the exchange rate.

Bruno,³³ in a paper mainly devoted to the development of a programming model for Israel, again makes reference to the foreign exchange constraint and the "dual nature of the balance of payments constraint,"³⁴ and remarks that "The experience of a number of developing economies, so far, seems to place the bottleneck mainly on the foreign exchange supplying side...."³⁵ Accordingly, Bruno incorporates the exchange gap in his program.

Adelman and Chenery³⁶ used a similar approach to Greece to the one applied by Chenery and Bruno to Israel. Their overall intent was, however, more theoretical, the objectives being to determine, by econometric techniques, "(1) the effects of aid on growth, and, (2) the policy problems presented by dependence on external assistance."³⁷ They estimated by time-series analysis an econometric model of the Greek economy which embodied basic aggregate demand relationships as well as the determination of a foreign-capital requirement. Later they supplemented the model with an estimate of the aggregate incremental capital-output ratio. As always, limitations in the data and the requirement that the model be applicable for planning purposes limited the choice of relationships which could be postulated, including in particular the production function. The econometric model

³³Bruno, op. cit.

³⁴Ibid., p. 549.

³⁵Ibid., p. 550.

³⁶Adelman and Chenery, op. cit.

³⁷Ibid., p. 1.

used evidently was highly predictive, however (it did not include the capital-output relationship), and hence the demand elements, including in particular the estimates of import requirements by sectors with respect to gross national product and the relative price of imports, were evidently quite accurate. (The relative price of imports was significant in the determination of the importation of all categories except food, beverages, tobacco, and animal and vegetable oil, which were treated as a single category.³⁸ Moreover, the fit was relatively poor in the case of that category. It is tempting to speculate that internal population growth and the output of the domestic agricultural sector might have provided a better explanation of the food import variable.)

Finally, an attempt was made to assess the past effects of foreign aid. Adelman and Chenery find that so long as imports were the bottleneck, an increase of one unit in foreign aid permitted an increase of 2.61 units of gross national product. It is also worth noticing that in the case of Greece, on the basis of Adelman and Chenery's results, an increase in the index of the price of imports of one unit would increase the gross national product by 344.9 units,³⁹ with a given level of imports, by inducing the substitution of domestic for imported goods. Unfortunately, Adelman and Chenery do not estimate the loss in gross national product through a decrease in the prices of imports. Since exports are determined, within the model, by time only, that term would increase from year to year. In

³⁸ Ibid., p. 6.

³⁹ Ibid., p. 8.

1954 it would have been 159.21, in 1959 221.85. It appears that Greece was far from exhausting the potential for substitution of domestic goods for imports, a fact which may reflect the large volume of aid Greece received beginning quite early.⁴⁰ On the other hand, when growth is limited by saving, a unit increase in capital inflow would result in an increase in gross national product of only 3622 units.⁴¹

Adelman and Chenery find that the savings constraint was the effective constraint in Greece through about 1956, while in subsequent periods the import constraint is the effective one, and is likely to remain so and become more stringent in future periods. They estimated that had the rate of economic growth been only two percent, instead of six percent, capital inflows of 16 billion drachmas would have been sufficient instead of the 75 billion which did in fact occur.

The conclusions drawn by Adelman and Chenery are that a) Greek use of foreign aid has been quite successful, and b) substantial structural changes are required if Greece is to approach self-sufficiency in the foreseeable future. Adelman and Chenery express cautions with respect to their use of econometric techniques based on partial information and aggregated data but find that their conclusions are not very sensitive to moderate errors in estimating.

Chenery and Strout⁴² stated the overall theory of import-limited growth more completely in 1966. There, "in the short run--for periods of five to ten years--we will describe such an economy

⁴⁰Ibid., p. 2.

⁴¹Ibid., p. 9.

⁴²Chenery and Strout, op. cit.

by a set of linear relationships in the Harrod-Domar tradition...." but "for longer periods, we will use a model on the neoclassical view that domestic resources can be substituted for imports...with diminishing productivity."⁴³ The shortcomings of this sort of short-run view have been mentioned before. They then distinguish two growth "stages": a stage of "investment-limited growth" when only the limits of domestic skills (including entrepreneurial skills) and saving are relevant to the growth process, and a stage of "trade-limited growth," when the balance-of-payments limit is effective. They assume a target rate of growth is set by the country and that the level of foreign capital inflow adjusts to it more or less passively. The incremental capital-output ratio and the incremental saving rate are both assumed constant. The ability to invest is assumed to increase at a constant rate: it represents the limited supply of skilled labor and entrepreneurship. They find that the growth rate of the country will be limited first by the ability to invest, as the growth rate increases, and then by the target growth rate. The "target growth rate" reflects the planners' expectations about the quantity of aid which will be available; they do not expect that aid will be forthcoming to sustain a higher growth rate. That is one reason why the target rate is limiting. These two possibilities are referred to as Phase I and Phase II respectively. During Phase I and Phase II the capital inflow required to support the target growth rate is the difference between desired saving and investment. Chenery and Strout assume that saving is inadequate and that positive inflows are necessary. That is, they assume that savings

⁴³Ibid., p. 682.

will not be frustrated by the inadequate growth of the capacity to invest, i.e., by a shortage of skills or entrepreneurship. This depends on their assumptions that the capital-output ratio and the rate of growth of the ability to invest are both rather high.

Trade-limited growth is characterized by an effective constraint that additions to imports be in a constant proportion to increases in the gross national product, "This import requirement results from the relatively inelastic demand for a large proportion of the manufactured goods currently imported--particularly intermediate goods and investment goods--arising from the lack of domestic supply and their necessity in production."⁴⁴ It is also characterized by some difficulty of increasing exports.

Since export earnings for many primary products are largely determined by demand conditions, a rapid increase in exports typically requires the development of export products, which is limited by productive capacity as well as organizational and institutional factors. The order of magnitude of this limit...median value is 5.1 per cent and upper quartile value is 8.0 per cent.⁴⁵

This result is based on 1957-62 data in dollars, hence the effect of gross barter terms of trade changes are allowed for. Unfortunately Chenery and Strout do not break the trade balances down by advanced and underdeveloped countries, so it may be that some of the exports generated were exports to other underdeveloped countries. Figures for the underdeveloped world as a whole would be desirable.

It is suggested that trade-limited growth will most likely commence at some time during Phase II, and hence the trade-limited phase

⁴⁴Ibid., p. 689.

⁴⁵Ibid., p. 689-690.

is designated Phase III. The capital inflow now required for growth at the target rate exceeds that required to supplement domestic saving, and hence some domestic saving is frustrated if growth proceeds at the target rate. It is now possible to calculate the amount of external assistance required for the transition to self-sustaining growth.

Next Chenery and Strout illustrate the use of their approach by reviewing the case of Pakistan, which has also been reviewed in a paper by Chenery and McEwan.⁴⁶ Pakistan is seen as having been in Phase I through 1963, while Phase II is seen as lasting from 1964-67 or from 1968-73 depending on the success of Pakistan in achieving its target growth rate of 6.0 percent. Still in the context of the Pakistani case, Chenery and Strout now consider the possibility of altering the parameters in the direction of a smaller import requirement. They note that if the import surplus requirement is greater than the increment of saving necessary to achieve the target growth rate, some potential savings will be frustrated. This reflects their assumption that once the target growth rate is achieved, the country will maximize consumption; i.e., that the government of the underdeveloped country essentially wishes to maximize consumption subject to a growth constraint. What it means in the present context is that some potential saving will be available for such purposes as import substitution even if, as Chenery and Strout assume, import substituting investment involves a higher capital-output ratio than non-import-substituting investment. The optimum longer-run program then is one which involves just enough import-substituting investment that the requirement of foreign

⁴⁶Op. cit.

capital to finance investment for the target growth rate is equal to the requirement of foreign capital for balance-of-payments equilibrium. This process will lead to growth which is both self-sustaining and independent of further aid in a minimal time.

Chenery and Strout then broaden their approach to longer-run growth with import substitution to be applicable as a general model to all countries, and derive formulae for the productivity of external resources which are applied to Pakistan and to median values for all underdeveloped countries. The marginal productivity of external resources is computed as Chenery and Bruno computed it for Israel.⁴⁷ For Phase II growth (i.e., when the saving constraint is binding) the productivity is .44 in Pakistan and .35 on the basis of median parameters. In Phase III, when the balance-of-payments constraint is applicable, the productivity is 1.14 in Pakistan and .91 on the basis of median parameters.⁴⁸

Next, Chenery and Strout divide the underdeveloped countries into four groups on the basis of past performance, according to whether they meet the trade and saving criteria of efficiency implied in the model, or only the saving criterion, or only the trade criterion, or neither. They note that failure on the trade side seems as important as failure on the savings side. Moreover, a high growth rate of exports is strongly correlated with success; ten of twelve countries with success according to both criteria have growth rates of exports (in dollar terms, it ought to be recalled) of six percent or more.

⁴⁷Op. cit., p. 702; see note 31, p. 19 above.

⁴⁸Ibid., p. 702.

Similarly, export stagnation characterizes the all-around failures. In that group of ten countries, the highest growth rate of exports is 6.1% per year, for Chile, and only two of the countries have growth rates in excess of 3.3% per year. The growth rate of exports, in dollar terms, measures the net effect of increases in the demand for exports and the offsetting decrease in price which would result from increasing quantity supplied.

Finally, Chenery and Strout project that an average growth rate of 5.8% should be obtained by assistance in the amount of \$13 billion per year, over the next fourteen years, assuming plan performance and high exports. This amounts to \$173 billion in all. A fall in the growth rate to 4.4% per year requires \$142 billion.

The imports-limited growth models of Chenery et al. are concerned first and foremost with applicability to policy recommendations, usually based on techniques related to mathematical programming. This both limits and forms the kinds of hypotheses which can be tested. Other studies of the optimum development strategy of an individual country have assumed that the balance of payments is a constraint of the growth process,⁴⁹ but Chenery and his associates have set out a theory of import-limited growth and of the implications of the import limitation while examining the growth prospects and strategies of individual countries and finally of the entire underdeveloped world.

⁴⁹Manne, A. S., "Key Sectors in the Mexican Economy, 1960-70," in Manne and Markowitz, Studies in Process Analysis (New York: McGraw-Hill, 1963); Eckaus, R. S. and Parikh, K. S., Planning for Growth: Multi-sectoral, Intertemporal Models Applied to India, Center for International Studies, Massachusetts Institute of Technology (April, 1966), mimeo.; Masson and Theberge, "External Capital Requirements and Economic Development," Journal of the Royal Statistical Association, Series A, CXXX, 3(1967), pp. 865-887.

That theory differs from the other theories (and may be less satisfactory as theory) in ways that will be explored in Section Four of this chapter. However, much of the credit for the growth of any such theory clearly belongs to Chenery and his associates.

II. McKinnon and Diwan: Theory and Test

The purpose of this section is to briefly review the more theoretically-oriented contributions of McKinnon⁵⁰ and Diwan.⁵¹ In addition, for purposes of comparison and contrast, it will include a review of one of the few statements of a classical theory of trade in capital goods, a short paper by Baldwin.⁵² That paper is described as "classical" in the light of its assumptions, which are those of the comparative-advantage model in its modern incarnations⁵³ except that one of the two goods assumed is a factor of production.

McKinnon describes his work as in many ways a "simpler exposition of several ideas given by Chenery and Bruno...."⁵⁴ and he begins by assuming a fixed-proportions production function in the two components of the capital stock, domestically produced capital goods and imported capital goods. As a first approximation he assumes that only capital goods are imported. The terms of trade are fixed, saving can take on any value below a maximum which is, of course, less than unity, and

⁵⁰Op. cit.

⁵¹Op. cit.

⁵²Op. cit.

⁵³See, e.g., Heller, International Trade (Englewood Cliffs, N.Y.: Prentice-Hall, 1965).

⁵⁴Op. cit., p. 389.

gross national product is equal by assumption to gross domestic product. There is a maximum of exports also, which is a fixed proportion of national output. The economy either grows at the Harrod-Domar rate, with excess exports, or grows at an export-limited rate, with excess potential saving, depending upon which growth rate limit is smaller.

However, McKinnon proceeds further. First, he introduces explicitly the requirement that some imports for current consumption be made. Since he has in mind that these are raw materials, or semi-finished goods, he incorporates them into the production function, which is again of the fixed-coefficients type. (Since the effect is simply to introduce another constraint in terms of imports, it makes no difference really whether the imports enter into the productive system or not, so long as there is no possibility of substituting domestically produced goods for them. This might be an important consideration if there are other irreducible import requirements, such as food imports in countries whose agricultural sectors cannot produce sufficient food to maintain the population.) Together with the constraints already assumed, this implies three possibilities:

- 1) The country may be able to import enough to supply the required imported capital goods for maximal growth as well as the required intermediate and raw materials and other irreducible import requirements to maintain full capacity.

- 2) The country can import enough goods and services to meet its irreducible requirements and maintain full capacity, but the excess above that amount is insufficient to supply the imported capital goods required for growth at the Harrod-Domar rate.

3) The country cannot import enough goods and services even to meet its irreducible import needs.

In case 1), the economy grows at the Harrod-Domar rate. In case 2) the economy grows at the export-limited rate, which depends upon the capacity to import, the proportion of capital-goods which must be imported, and the productivity of imported capital goods. In case 3) no growth is possible; indeed no output is possible within the model, although, as McKinnon speculates, the model is undoubtedly deficient on this point.

Here McKinnon introduces the possibility of foreign capital inflows. He finds that as the foreign transfer increases as a proportion of output, the country may, on the most pessimistic assumptions, pass successively through stages 1) in which aid will have no effect, within the limits of the model, 2) in which aid will have a maximal effect, since each unit of aid will not only add a corresponding quantity of imported capital to the country's capital stock, but will permit the addition of a corresponding quantum of complementary domestic capital goods, and 3) in which the effect of aid will be decreased, since it will serve only to increase the effective proportion of income saved. Thus the growth rate may be considered as a function of the foreign transfer, and displays diminishing returns beyond a certain level.

In the linear model as developed by McKinnon in the first two sections of his paper, the country could not become self-sufficient at a growth rate higher than that provided for by its own exports. Thus McKinnon, following Chenery and Bruno, introduces the concepts of the target rate of growth and the differing average and marginal

rates of saving and export. He finds that if either the average propensity to save or the average propensity to export increases with growth (and presuming that the average propensity to import, or, rather, the irreducible import minimum as a proportion of output, is constant), the country may be able to attain self-sufficiency at a high growth rate in a predictable number of years. The number of years and the total required capital inflow vary inversely with the marginal savings rate and the rate of saving required for the target of growth, and hence, i.e., with the target rate itself insofar as it is feasible.

Finally, McKinnon introduces the possibility of substitution of domestic production for imports into the model. To do this he replaces the fixed-proportions production function with a constant elasticity of substitution (CES) production function originally proposed by Arrow, Minhas, Chenery and Solow.⁵⁵ This function is characterized by a constant elasticity of substitution among the factors, hence the abbreviation CES. While it is beyond the scope of this paper to consider the mathematics of such a function, it may suffice to say that it approaches the Cobb-Douglas form as the elasticity of substitution approaches one, and the fixed-coefficients type as the elasticity of substitution approaches zero. It may, i.e., be regarded as an intermediate case involving substitution with some difficulty and cost. Accordingly, McKinnon explicitly rejects the

⁵⁵Arrow, Chenery, Minhas, Solow, "Capital-Labor Substitution and Economic Efficiency," Review of Economics and Statistics, LXIII, 3 (August 1961), pp. 225-50. For a more recent discussion of the CES function and its uses and drawbacks, see Solow, "Some Recent Developments in the Theory of Production," in M. Brown, Ed., The Theory and Empirical Analysis of Production (New York and London: NBER/Columbia University Press, 1967).

Cobb-Douglas version.

Diwan, following Chenery et al. but unlike McKinnon, fails to distinguish between imports of capital goods and imports of raw and semifinished materials.⁵⁶ Rather he writes output as a function of domestic capital and imports, and proposes to test statistically for such a relation. More realistic, he grants, would be a production function with an explicit labor input, but he feels that the assumption that labor is abundant justifies deleting it. Moreover, this is statistically convenient, since the growth of the other two inputs will tend to be highly intercorrelated with that of labor, which might make it impossible to test the proposition.

Diwan's results seem to be flawed by his choice of a production function to estimate. He used the Cobb-Douglas form, which, as noted above, is ill-suited to the assumption of difficulty in substituting domestic for imported factors of production, although it is very convenient statistically. The coefficient for imports is on the order of .09, which would mean that a one percent increase in imports would permit nine-one-hundredths of a percent increase in output. However, the coefficient is clearly statistically significant, and the explanatory power of the relation is better than the corresponding log-linear equation for capital alone.⁵⁷ It is worth mentioning that the linear form gives an equally good fit, and a quite high marginal product of imports.⁵⁸ This linear form is not the fixed-

⁵⁶Op. cit., p. 531.

⁵⁷Ibid., p. 533.

⁵⁸Ibid., p. 537, note 12.

proportions form but an additive one, however, and it is difficult to say just what either of Diwan's results mean for the parameters of a fixed-proportion model.

Diwan's data are for India. They have some faults for this kind of analysis, inevitably, but Diwan meets the arguments against the data as follows: 1) capital and imports can hardly be expected to be independent as least-squares analysis requires, since some capital goods are imported. However, investment tends to be on the order of one-thirtieth of the capital stock, and it follows that capital imports are about one one-hundredth of the capital stock. In addition, they enter into the determination of the capital stock in a "complicated and nonlinear way."⁵⁹ Thus they are effectively independent. 2) Although total capital estimates in lieu of domestic capital estimates have been used, the total capital estimates are to be regarded as a proxy for domestic capital.

This last point hardly seems satisfactory from a theoretical point of view. However, it would seem that this difficulty would prejudice the estimate against the hypothesis that imports enter into the productive system as an independent factor of production, since the coefficient for capital would actually include part of the effect of imports. Thus, contrary to Diwan's assertion, it hardly seems proper to regard the production function as a "decision function, decision being the substitution of 'domestic capital' for imports."⁶⁰ However, it does seem to be possible to conclude that in the case of

⁵⁹Op. cit., p. 534.

⁶⁰Ibid., p. 534.

India, imports may fruitfully be regarded as a factor of production.

Baldwin's note⁶¹ seems to fill a rather puzzling gap in the theory of international trade when all goods can be produced by all countries, i.e., comparative advantage theory: that is, the case in which one of the goods traded is a capital good. Since Baldwin assumes that there are just two goods, two countries, and two factors, one might better say, one of the goods is the capital good. Baldwin's method is comparative statics, and he assumes identical tastes among all individuals in each country, no technological progress, and diminishing marginal rates of substitution in production. Following Leontief,⁶² he assumes that individuals make their savings plans in the light of the existing transformation curve between present and future income, but then revise them in succeeding periods as increases in the stock of capital bring about outward shifts of that transformation curve. In this universe, an isolated country will approach a stationary state in which next year's expected income is equal to this year's and no additional saving takes place. If trade is opened between two countries, as usual, the one with a comparative advantage in the capital good will export it. Assuming that future income is not an inferior good, the rate of saving will increase in the capital-importing country. (Actually this assumes also that the decrease in the relative share of capital in income as a result of factor-price equalization in trade does not decrease the propensity to save

⁶¹Op. cit.

⁶²"Theoretical Note on Time-Preference, Productivity of Capital, Stagnation, and Economic Growth," American Economic Review XLVIII, 1 (March, 1958), pp. 105-111.

to a degree that offsets the effects of a lower price of capital goods and hence of next year's income in terms of this year's. This interesting qualification is mentioned only in passing, in a footnote.⁶³⁾ The growth rate of the capital-exporting country may either increase or decrease. The two countries will again approach their stationary states, and if the tastes with respect to present and future income are identical as between the two countries, the capital-labor ratios will be identical. World income will be higher than in the no-trade case, in the stationary state, and the rate of interest will be the same in all countries which produce some of both goods.

This is hardly a surprising result in the light of the assumptions which are required to produce it, and they clearly imply that this theory is not meant to apply to trade between the advanced and underdeveloped countries. They include "that the full set of assumptions needed for factor-price equalization be satisfied,"⁶⁴ that each country produce some of each good at the outset, that the capital good "is assumed to be uniformly capital-intensive compared to the consumption good,"⁶⁵ and that the aggregate saving behavior of both countries is as though all residents of each country had identical tastes as between present and future income. The factor-price equalization assumptions include the identity of the production functions⁶⁶

⁶³Baldwin, op. cit., p. 895, note 7.

⁶⁴Ibid., p. 845, note 9.

⁶⁵Ibid., p. 884.

⁶⁶See Heller, op. cit., pp. 93-101; Samuelson, Paul, "International Trade and the Equalization of Factor Prices," Economic Journal, LVIII, 2 (June 1948), pp. 163-184.

and that there be no more commodities than there are factors. This last means that the assumption of just one capital good, or in effect that both countries produce all capital goods and moreover produce them in identical proportions, is not a simplifying assumption but basic to the results obtained. This thus excludes, by assumption, both the dynamic process leading to a factor-proportions problem described in chapter four below and the idea of an import minimum due to requirements of raw and semi-finished materials which cannot be produced in the developing country. In short, its applicability is limited to the developed countries.

Baldwin says, "It may be increasingly useful to regard international trade, especially among more advanced countries, as essentially an adjustment process in response to a disequilibrium situation." It is easy to concur, especially if we may qualify the statement by the observation that the adjustment process may actually be disequilibrating as well as equilibrating. "Therefore, trade should be regarded as based on such factors as short-run differences in the knowledge of productive techniques," i.e., short-run differences in the production functions of the different countries, "and differences in tastes--a factor that may also be best regarded as short-run. Differences in the rate of population growth, differences in preference changes, etc., may well maintain the relative importance of international trade, but the pure theory of trade should make clear the dynamic forces tending to reduce trade." It should also make clear the dynamic forces tending to increase or bias trade, if such forces exist, as they evidently do. "By ignoring capital-goods trade that is financed by current exports,

international trade theory has failed to do so."⁶⁷

By virtue of its highly abstract character, it is doubtful that Baldwin's theory is adequate even to trade among the developed countries. It is, however, a step in the direction of the theory of responsive trade which Baldwin invokes, and is useful as such. A more realistic model along the same lines, which could credibly posit equilibrating tendencies among trading countries on the sole condition that all are capable of producing each type of capital good, would seem to establish that the inability of some countries to produce some kinds of capital goods is not only sufficient, as shown in this paper, but necessary to explain developmental problems within an economic framework. This would be a service indeed.

III. Linder's Trade and Trade Policy for Development

The most comprehensive and complete statement to date of the import-limited growth theory is Linder's Trade and Trade Policy for Development. First, Linder recognizes the need for at least two theories of trade for underdeveloped countries, distinguishing what he calls "developing" and "backward" countries. It is in the case of the first that the import-limiting model is to be applied. Linder recognizes that this kind of theory has precedents in several tendencies of thought, and indeed disavows any claim to originality other than increased rigor. In this he may be too modest, since as he says, "theories of trade in underdeveloped countries will never be regarded as anything but assertions, so long as it is not carefully

⁶⁷All of the preceding quotations in this chapter are drawn sequentially from the second paragraph, op. cit., p. 847.

explained why conventional theory cannot be used as a general theory applied with equal validity to developed and less developed countries."⁶⁸ Moreover, "...and this is a special aspect of the formulation of more rigorous theory, it is necessary to define exactly under what circumstances and to what extent conventional theory is, in fact, applicable to underdeveloped countries."⁶⁹ Hence Linder is proposing a theory which is new, as theory, even though its conclusions are those which have been adduced on less systematic grounds before, by and large. Actually, although the works of Chenery and Bruno, McKinnon, and others cited above, are as he says, "even more reminiscent...of the analytical framework suggested here....it is never demonstrated in these writings how, considering the analysis of existing trade theory, a foreign-exchange constraint could prevail without simply being the reflection of insufficient domestic savings or inept expenditure policies. To show this would seem to be the crucial task...."⁷⁰ Linder does improve on their theories in this sense, but his solution leaves a bit to be desired.

Linder distinguishes among categories of imports which are necessary as inputs to the developing economy:

The development process then requires certain expansion imports, in the absence of which growth potential (in the form of a net savings potential) could not be fully exploited, and, in order to keep existing capacity unchanged and to avoid the frustration of savings for reinvestment, reinvestment imports, in the form of capital goods to replace former

⁶⁸Linder, op. cit., p. 7.

⁶⁹Ibid., p. 7.

⁷⁰Ibid., p. 71.

expansion imports; together these constitute investment imports. In order fully to utilize existing capacity, there must also be certain operation imports--spare parts to imported capital goods and nondomestic primary products. Reinvestment and operation imports together constitute maintenance imports. All of these input imports are necessary to avoid underutilization of existing resources and frustration of the growth potential, and it is assumed that they can be secured only from advanced countries.⁷¹

However, some capital goods can be domestically produced.

For Linder, "The input-import requirement constitutes a factor-proportions problem."⁷² which is, however, of a different nature from that described by Eckaus.⁷³ This factor-proportions problem arises out of limited substitutability of domestic and foreign resources. Thus, not only labor, as in Eckaus's model, but also domestic capital resources, may be unemployed as a result of the shortage of the scarce factor. Linder asks why there is limited substitutability and responds that underdeveloped countries seek modern techniques, which require expansion imports, because 1) of a "demonstration effect" in capital goods and considerations of national prestige, 2) simple techniques cannot simply be taken over from other countries, which have largely forgotten them, and hence the use of simple techniques would require so much invention and experimentation that the benefit would be lost. Linder is unconcerned with whether the demand for modern capital goods is strictly rational or not, but he regards it as a fact. More, even if substitution is possible, "a

⁷¹Ibid., pp. 11-12.

⁷²Ibid., p. 13.

⁷³Eckaus, R. S., "Factor Proportions in Underdeveloped Areas," American Economic Review, XLI, 4 (September, 1955), pp. 539-65.

country might still, of course, face a factor-proportions problem. This situation would arise when the substitution of domestic factors for imported inputs could not be carried any further."

Linder then proceeds to give an algebraic exposition of a model basically similar to that of McKinnon,⁷⁴ and to observe that if the capacity to import is inadequate to supply the total import requirement, including sufficient expansion imports to permit new investment equal to desired net savings at full employment, saving will be frustrated. This may take place either through a decrease in the propensity to save or a Keynesian decrease in aggregate demand, or both. The decrease in realized saving that results may come about partly through decreasing new investment, but it also may represent redirection of imports from operations imports to investment imports, and hence a decrease in capacity use. Further, an increase in investment may actually bring about a decrease in capacity use. This concept of frustrated saving is, as Linder says, directly taken over from Hirschman.⁷⁵

Linder observes that all countries face a problem of rigid import requirements to maintain production, so that cannot be all there is to the problem of the underdeveloped countries. However, in the developed countries, those requirements may be relatively minor. (Europe after World War Two is cited as an exception.) In particular, their imports are usually limited to operation imports. Rather, the difficulty of the underdeveloped countries stems from the fact that

⁷⁴Op. cit.

⁷⁵Hirschman, A. O., Strategy of Economic Development (New Haven and London; Yale Press, 1958), p. 37. Linder op.cit., p. 18.

they have an export maximum as well as an import minimum. A major part of Linder's theory is devoted to explaining this fact.

It is fairly clear that there may be an export maximum for a single export good if the demand is inelastic, the returns to scale diminish, or both. However, when difficulties of expanding output in a single sector occur, why should not new export industries be added? It is clear that the underdeveloped countries have some difficulties along those lines, and Linder explains this by the hypothesis of representative demand. This hypothesis states that countries tend to have a comparative advantage in the production of goods typical of their own demand structures. Thus as they attempt to add exports of products more nearly typical of the demand patterns of the developed countries, they are likely to find themselves unable to compete. This is an interesting and appealing hypothesis, and very possibly a correct one. It deserves study. However, it is not necessary to the import-limited growth theory. The export sector may be regarded as having two margins of production, an intensive margin representing expanded production in existing export industries, and an extensive margin representing the addition of new export industries. The maximum of exports, in value terms, can then be attained when each resource is allocated in such a way that its marginal revenue product is equal on the two margins. Expansion on either margin then requires more resources, including imported ones. However, the shortage of the latter is the difficulty. Linder's representative demand hypothesis, if proven, would be a valuable contribution in that it would explain why the two MRP curves take the form they seem to, i.e., causing a concentration on particular export products.

However, to suggest that an underdeveloped country can expand its exports by reallocating its resources in the direction of new export industries is to assert that the allocation is not now rational. This may very well be true, but it is wildly at odds with the perfect competition-profit maximizing assumptions that underlie the theory of comparative advantage.

Another point Linder makes with respect to the comparative advantage theory is that, by ignoring the differences in absolute productivity between two countries, it obscures the fact that one country may fail to produce one good in the pretrade situation because the production of it does not permit subsistence factor payments. The productivity of labor increases with increasing capital per worker, regardless of scale economies. If, in the "pretrade" (and predevelopment) situation, capital goods cannot be produced with subsistence wages, there will be a minimal capital-labor ratio for which such production can be undertaken. (It may be, of course, that the ratio is smaller as the scale is larger.) Then, the least developed countries will produce the smallest range of capital goods, and the range of domestic production will rise as the overall capital-labor ratio rises, permitting more and more capital-intensive (relative to subsistence wages) activities to be undertaken.

Linder then draws several theoretical conclusions as follows:

- 1) The nature of the gains from trade is different, since imports function not to improve the allocation of resources but to assure their full employment. Linder describes trade as a potential superengine of growth, rather than just an engine of growth.

- 2) The comparative-cost doctrine has limited validity.

3) Internal and external balance cannot be simultaneously achieved.

4) The usual kind of savings-investment equation must be modified.

5) Capital imports do not supplement scarce domestic resources, but complement abundant domestic resources.

6) The basic postulate of the pure theory of international trade is not fulfilled.

Linder then turns his attention to the possibility of empirical proof of the theory. He points out that the establishment of the theory as proven would require studies of the substitutability of domestic for foreign resources, the relationship of input imports to capacity use and growth, and the effects of expenditure policies on the export potential. He does not undertake such extensive studies, but he does review the statistics and literature, to attempt to determine whether the import minimum and export maximum are relevant concepts, and whether there are in fact any countries unable to meet their import requirements. He notes that the course of investments and imports over time are quite similar in Latin America, and, indeed, he finds a correlation between them with gross internal fixed investment equal to 0.019 plus 1.0576 times imports, and a regression coefficient of .98. As Linder points out, such a correlation says nothing about causation, and the conventional theory would predict a good correlation, since investment would determine income and income would determine imports.

Linder does not attempt to demonstrate the existence of a rigorous export maximum, but reviews the difficulties of underdeveloped countries in expanding exports. He points out that exports of

manufactured goods are small and growing smaller as a percentage of world manufactured exports. (His data apply to the entire underdeveloped world.) Moreover they are in large proportion simple base-metal manufactures. The total exports of the underdeveloped world have increased less rapidly than the exports of the developed countries.

The question of the existence of an "acute foreign exchange gap," i.e., a situation in which a country cannot meet its minimum import requirements, is more difficult to resolve. It is possible that balance-of-payments problems may result from inept expenditures policies in Linder's schema as it is in the conventional theory. Moreover, it is difficult to identify input imports in any certain way. For example, scotch whiskey in certain quantities is an input import in Mexico due to the demand for it by American tourists. It is clear, however, that virtually all underdeveloped countries now practice extreme import limitations, so that it seems difficult to ascribe the balance-of-payments problems that do exist to imports of nonessentials. Linder takes underutilization of capacity in underdeveloped countries to be an indication of foreign-exchange constraints, as do several writers he cites, but there is also, of course, the possibility that such underutilization of capacity represents instead market limitations, poor investment planning, or a combination of the two.

A more interesting argument of Linder is that frustrated saving can be observed in Latin America. Again, of course, the meaning of the evidence cited is not indisputable, but it is indicative. Linder calculates an estimate of the minimum of frustrated savings for the

years 1953-60 in Latin America on the assumption that the highest saving propensity for the period, which was that for the initial year, represents the "true" potential savings propensity. If there was an acute exchange gap in 1953, so that saving was frustrated in that year, the estimates would have to be revised upward. Moreover, there was no compounding. Notwithstanding, Linder calculates that \$8 billion in saving was frustrated during the seven-year period, primarily in the last four years.

Linder now goes on to considerations of policy. He points out that when there is a potential exchange gap the demand curve for foreign exchange may not, and when there is an acute gap does not, intersect the supply curve. An interventionist trade policy may be called upon to alleviate such a problem, but there is a potential conflict of such policy with the allocative functions of trade. However, Linder argues that the conflict is not realized insofar as the interventionist policy increases capacity use, and the increase in capacity use could not be gained through expenditure policies, as the theory implies. The allocation changes due to intervention involve the use of domestic resources which would otherwise be unemployed, and hence their social cost is zero. Of course, if domestic resources are redirected into activities with a negative value added, there would be allocation losses. Moreover, the absence of conflict between allocation and capacity use considerations is only true when there is an acute foreign exchange gap.

Among the policy recommendations with respect to the specific goals of intervention, Linder mentions the restriction of non-input imports, shifting the supply curves of exports, and shifting the

demand curves of exports. The policies recommended are, broadly speaking, familiar, but the fact that they have a different motivation from the traditional protectionist motivations leads to different efficiency criteria and to the expectation that in a given situation, the quantitative recommendations would differ from those based on traditional protectionist arguments. For example,

It should be pointed out that the difference in the process that is assumed to be started by protection in the two approaches means that protection to cure a foreign-exchange gap cannot be labelled as "beggar-my neighbor" policy. The purpose is not to increase effective demand at the expense of products within the scope of total imports, the volume of which there is no wish to reduce.⁷⁶

Just the contrary is so. Moreover, the gross barter terms of trade is a poor criterion for policy choice in the developing country; preferable is a concept of "what may be referred to as the 'net income terms of trade.'" These terms would measure the capacity to make input imports after deducting those input imports which are required for export production."⁷⁷ The unconcern of the underdeveloped country with its gross barter terms of trade means that the effect of optimum protection in the underdeveloped country on the welfare of the developed country is indeterminate. There is no presupposition that the developed country will lose by such protection, and it conceivably may gain.

Linder examines the optimum policy of the developing country with respect to capacity imports with attention to the fact that debt service compounds the balance-of-payments problem. This problem will

⁷⁶Op. cit., p. 86.

⁷⁷Ibid., p. 99.

be considered in a later chapter⁷⁸ and further reference will be made to Linder's analysis there. He then examines the implications of the theory of import-limited growth for trade integration in the developing countries. Again, review of his comments on this subject is deferred to a later chapter.⁷⁹

Linder then goes on to examine the theory of trade with respect to "backward" underdeveloped countries, i.e., those in which there is neither a foreign-exchange gap nor growth. He points out that the opening of trade in such countries has its impact primarily through changes in the relative prices prevailing in the backward country. However, since the rigidities characteristic of such backward countries imply that resources will not be reallocated in accordance with the new price system, the conventional theory is not applicable without modification. Either incomes or employment will be reduced in import-competing sectors, and since subsistence incomes are likely, unemployment is expected. (Since there are, notwithstanding, some gross gains from the reallocation of consumption, the welfare result of the opening of trade is indeterminate.) This assumes there is an import-competing sector, however, and there may not be one. For example, the goods imported might be either capital or consumption goods of a kind entirely new to the importing country. If there is an import-competing sector, there are potential gains from trade if an income transfer from the export sector to the factors of production of the import-competing sector is feasible, and leaves a

⁷⁸Below, p. 140.

⁷⁹Below, p. 113.

surplus, and if it does in fact take place. (Otherwise, the import-competing sector will be extinguished.) It is, however, questionable whether such a transfer is politically feasible, and no certain conclusion can be drawn if it does not actually take place. Measures aimed at improving the gross barter terms of trade may play an important part in the optimum trade policy of such a country, since if the transfers made above are unnecessary due to the absence of an import-competing sector, the country's essential position is one of venting its surplus.

IV. Some Recent Contributions

This section will consider three recent contributions to the two-gap theory: a study of external borrowing and growth by Slater,⁸⁰ and the neoclassically-oriented critiques of two-gap theory by Bruton⁸¹ and Nelson⁸² together with Chenery's⁸³ reply to Bruton.

Slater's primary purpose is to determine the impact of inflows of foreign capital on the growth of investment in a selection of fifteen underdeveloped countries.⁸⁴ He finds that the inclusion of two-gap elements in an Avramovic model of foreign borrowing⁸⁵ "improve its

⁸⁰Op. cit.

⁸¹Op. cit.

⁸²Op. cit.

⁸³H. Chenery, "Reply," American Economic Review, LIX, 3 (June 1969), pp. 466-7.

⁸⁴Op. cit., p. 254.

⁸⁵Economic Growth and External Debt. v. I, ch. V. (Baltimore: Johns Hopkins University Press, 1964).

relevance to actual experience."⁸⁶ In the particular case of Chile, Slater found that the following relationship held among imports of goods and non-factor services, consumption, and fixed capital formation, in millions of 1961 escudos:⁸⁷

$$M' = -154.86 + 0.06853C + 0.7202I$$

(2.72) (2.37) (4.51)

Here, the figures in parentheses are t-ratios; M' is imports, C consumption, and I investment. The estimate is based on data for 1947-64, eighteen observations in all. $R^2 = 0.944$, the standard error of estimation is 39.648; and the Durbin-Watson statistic is 1.619, which indicates that auto correlation of the residuals is not significant at the 0.95 level of confidence. Slater's results for Chile are substantially better than those obtained in the study reported below; the form he fit was not tried in that study and the data are from a different proximate source.

In his critique of the two-gap theory as set out by Chenery and Strout,⁸⁸ Bruton argues⁸⁹ that the trade gap does not arise independently. Rather, he says, it is the result of unorthodox policy choices together with low savings rates. It is thus, to some extent, an iatrogenic disease, one, that is, resulting from treatment. The unorthodox policy choices are exactly those prescribed by Chenery, Linder and others to maintain growth in the short run: currency

⁸⁶Op. cit., p. 253.

⁸⁷Ibid., p. 258.

⁸⁸Op. cit.

⁸⁹Op. cit.

overvaluation with resulting balance-of-payments deficits, and foreign aid. Bruton says that the underdeveloped countries are dependent on imported capital goods precisely because imported capital goods have in the past been abundant. Had they not been, the underdeveloped countries could have attained a balanced growth, by using capital goods which they could produce rather than those which they could not. Admittedly this growth would have involved a somewhat higher ICOR and hence required higher saving ratios, ratios that governments were not politically able or willing to obtain. Since, in fact, the countries have had access to sources of capital goods from the developed countries, their capacity to produce those capital goods which they can produce domestically has not grown sufficiently to sustain a very high rate of growth today. The countries must be induced to depend more strongly on the kinds of capital goods which they can produce.

This is an appealing hypothesis. As Bruton points out,⁹⁰ the two-gap theorists have not adequately explained the origins of the trade gap. Those origins could be exactly what Bruton suggests they are: the inappropriate abundance of imported capital goods for several years past. However, Bruton's list of the kinds of capital goods he has in mind is not reassuring. It consists of "education, technical research, health...." while he assumes with Chenery and others that the country can not produce "machines, equipment, plant, and other forms of physical capital." It is clear that however much of the former may be available, there is an irreducible minimum of the latter which will be required for further production. If there

⁹⁰Op. cit., p. 440.

is some scope for the substitution of capital goods of the first type for capital goods of the second type which the underdeveloped countries have not actually exploited, then there is a present margin for reduction of exports. In the next chapter, however, it will be argued that in many countries, depending on the elasticity of demand and rate of increase of demand for exports together with the characteristics of the technology of the export sector, there will be a tendency for such substitution to proceed rather rapidly to its limits. Bruton states quite positively that this is not so. "Emphasis may be placed on the fact that this conclusion [the absence of any tendency to a trade gap] does not depend on assumptions as to the relative magnitudes of the several relevant elasticities."⁹¹

Bruton's critique does point out a number of inconsistencies in development strategies which support his view, in that they would tend to favor the expansion of consumption-goods industries rather than capital-goods industries. For example, in generally protectionist economies, capital goods may not be protected.⁹² Thus, importation of capital goods may be perpetuated by the protection patterns of the government. He fails to consider the other side of the argument, however, which is that capital formation in the other sectors may not take place if capital goods are protected, while it is unlikely that capital goods production will occur until there is a market for the capital goods within the country. This is the

⁹¹Ibid., p. 443.

⁹²Ibid., p. 444.

familiar argument of backward linkages, due largely to Hirschman.⁹³ This is a real dilemma. Bruton recognizes it as such, and calls in effect for its solution by planning. (It might be possible to switch protection to the capital good once a market exists for it. This assumes that the consumer-good industry which uses the capital good is then able to continue producing.) This may serve to point up the fact that the trade balance constraint is not the only obstacle in the way of economic development. This fact has been consistently recognized by two-gap theorists, however.

Bruton argues that with appropriate allocation of resources, there needs be no trade gap. In his reply,⁹⁴ Chenery grants the point. However, he locates cause in "inflexibility." He says that Bruton's results are valid for an economy which is flexible, by which he evidently means an economy in which there is scope for the productive substitution of domestically produced capital goods for imported ones. (Flexibility might imply other kinds of conditions as well, but this seems to be the operative one.) However, the argument need not end there. Linder,⁹⁵ as noted above, argued that inflexibility can itself be the result of the trade gap. There being an absolute shortage of imports, input imports in particular would be scarce, while domestically produced capital goods might be so plentiful as to have a marginal product of zero. Certainly, if a country already has very high proportions of domestic to imported

⁹³Op. cit.

⁹⁴Op. cit., June 1969.

⁹⁵Op. cit.

capital goods, it would hardly be expected that there would be much flexibility in the further substitution of domestic for imported goods.

Since Chapter Four will argue that Linder's factor-proportions problem can arise independently of the other elements, it follows that the factor-proportions problem may be the locus of cause. It would be for empirical analysis to determine whether it is in fact the locus of cause.

In Chapter Four a model is developed in which the composition of investment as between domestic and imported capital goods is an endogenous variable. With certain parameters for the elasticity of demand for exports, the growth of demand for exports, and returns to scale in the export and domestic capital production sectors, it is shown that the proportion of domestic capital goods to imported capital goods in new capital formation (and therefore in the total capital stock as well) will increase without bound, at or above a determinate constant rate, so long as the marginal product of domestic capital goods remains positive. It is argued that such a tendency underlies the factor-proportions problem observed by Linder. The model of Chapter Four assumes that savings are unlimited. This assumption is unsatisfactory, and is subsequently reconsidered. It seems, however, to indicate that Bruton's stress on high rates of saving as a remedy for the trade gap is misplaced. Other unsatisfactory assumptions are that the only inputs are domestic and imported capital goods and that these are distinct goods each of which is homogenous. These assumptions, too, are reconsidered in Chapter Four.

Although the model economy considered in Chapter Four is flexible, the conclusions drawn are opposite to Bruton's. They

depend strongly on the aggregate structure of the model, which differs from his, although less drastically than do those of most of the two-gap theorists. It is concluded that, Chenery to the contrary, Bruton's results derive not from his assumption of flexibility, but from his excessive aggregation. The proper degree of aggregation for purposes of theory is the greatest feasible degree which can explain the phenomenon under observation, since a more aggregative model is likely to be more widely applicable than a less aggregative one. However, a model which fails to distinguish between those capital goods which can, and those which cannot, be produced domestically can neither display, nor explain, a factor-proportions problem among capital goods. Such a model can tell us little about development, as Bruton's remarks make clear.

Nelson⁹⁶ is primarily concerned with the case of Colombia; however, he develops his thesis in general terms. First, he reviews the two-gap theory in a form which differs only in detail from the analyses of Chenery and Strout⁹⁷ and McKinnon.⁹⁸ Then he examines a model in which substitution is assumed to be possible. "All production functions are assumed to be linear homogenous, with positive marginal products which are always positive within the range of relevant factor variations. [sic] This last is a serious restriction on the shape of the isoquants or on the variation in factor inputs which the model implies."⁹⁹ So it is. Nelson also assumes that the

⁹⁶Op. cit.

⁹⁷Op. cit.

⁹⁸Op. cit.

⁹⁹Op. cit., p. 552.

domestic capital-goods sector is more import-intensive than the domestic consumers-goods sectors. He notes that this seems plausible for underdeveloped, but not for developed, countries.¹⁰⁰

In Nelson's model "the constants are turned into variables,"¹⁰¹ and the exchange rate plays an important part in their determination. For example,

$$\frac{K}{L} = \frac{F_1}{F_2} \left(\frac{W}{E}, i \right),$$

where $\frac{K}{L}$ is the capital-labor ratio, F_1 is the ratio of capital to output-capacity, F_2 is the ratio of labor to output capacity, and the latter two terms are both functions of $\frac{W}{E}$, the ratio of wages to the exchange rate, and i , the rate of return on capital. Now $\frac{K}{L}$ varies directly with $\frac{W}{E}$ and inversely with i . The other constants of the two-gap model are similarly responsive to changes of price in Nelson's model.¹⁰² Accordingly, "Under seemingly not unduly restrictive assumptions, there exists an $i, \frac{W}{E}$ combination, so that, for any consumption-investment ratio, full employment of all three factors is possible. Further, if these factor prices obtain, the output of the economy, given its M, K, L endowments, is maximal along that C, I ray."¹⁰³ However, "I will not engage, here, in any exegesis of the conditions under which the optimal exchange rate is also the rate which equilibrates supply and demand for foreign exchange in a competitive

¹⁰⁰Ibid., p. 548n.

¹⁰¹Ibid., p. 554.

¹⁰²Ibid., p. 555.

¹⁰³Ibid., p. 562.

market."¹⁰⁴

In fact, Nelson's limitations on the production functions are rather strong; but if they are met, it is certainly true that no trade gap can exist. Nelson assumes in effect that the country is potentially self-sufficient in terms of capital goods (and consumers' goods as well).

Nelson concludes that both consumption and investment can be increased by devaluing, with a given capacity to import. For consider the equation shown above: an increase in E , other things being equal, will reduce $\frac{W}{E}$ and thus decrease $\frac{K}{L}$. With unemployed labor and a given capital stock, L will be increased. By assumption labor has a positive marginal product, so output is increased. In Nelson's terminology, an increase in E is a devaluation. Hence, the sense of his model is the following proposition, which seems obvious prima facie: so long as domestic inputs can be substituted for imported ones with a positive marginal product, an increase in the expense of imports will reduce the quantity demanded.

The arguments of Nelson and Bruton thus agree. Nelson's statement is to be preferred because it makes the limits of this reasoning clearer. If 1) a country is unable, for whatever reason, to produce input good A , and 2) a minimum quantity of the good is required for each unit of output B , then 3) a trade gap can occur. Linder's argument¹⁰⁵ is that some input goods cannot be produced with

¹⁰⁴Ibid., p. 562.

¹⁰⁵Op. cit.

subsistence factor payments. If, as Bruton¹⁰⁶ would have it, any input is dispensible, there is still no likelihood of a trade gap. Otherwise, there may be.

The criticisms of Nelson and Bruton relate to a difficult policy dilemma which an underdeveloped country may face. On the one hand, a low price of hard currency will mean a low price for imported capital goods, which may stimulate the willingness to invest. The effect of tariff-protection of domestic consumers' goods and non-protection of capital goods is the same. This is essentially Hirschman's strategy of reliance on backward linkages. It has an undesirable side effect, however. It subjects domestic capital-goods production to even more difficult competition than it might otherwise face, thus essentially perpetuating dependence on imported capital goods. On the other hand, a high price of hard currency will mean high prices for capital goods, and so will protection of domestic goods industries. This will reduce the rate of return on investment, possibly below what can be obtained abroad.

Suppose instead that 1) a uniform tariff is placed on all imports regardless of use, and 2) a uniform subsidy of equal or larger magnitude is paid on all purchases of capital goods regardless of source. Then, on net, 1) capital goods would be subsidized and thus investment would be induced, 2) all domestic production would be at an advantage relative to imports, and import substitution would be induced. In practice, of course, the investment subsidy might not necessarily be uniform. Investment presumed to have high backward

¹⁰⁶Op. cit.

linkage effects might, for example, get a differential subsidy. In any case, it would appear that the dilemma can be side-stepped.

V. Summary and Conclusions

The analysis of Chenery and those associated with him and following his lead is strongly oriented toward the problem of the preparation of an optimum development plan. As such it has stimulated the more successful theoretical work of McKinnon and Linder.

However, such a pattern of growth of theory has some disadvantages, in that the appliers of the as-yet unperfected theory may fail to develop all of its aspects, their attention being focussed on the problem they are directly concerned with. This may result in some shortcomings of the initial policy studies as policy, since they will fail to see policy alternatives to which a full development of the theory would point. A major defect of the Chenery-et-al approach in this light is their failure to consider the optimum response of the underdeveloped country to offers of foreign loans in the light of the balance-of-payments problems entailed by debt service. They have concentrated too exclusively on transfers. Moreover, in their concentration on the possible gains from intra-country reallocations of resources, they fail to explore the possible gains from inter-country reallocations; i.e., the benefits of trade integration. Linder's study is far more satisfactory on these points in point of policy.

Moreover, no study prior to that of Linder has seen the need to explain the cause of the trade gap. This has left the two-gap theory open to such criticism as that of Bruton. It is possible that the

two-gap theory is beside the point, if the trade constraint is itself subject to manipulation by appropriate policy on the part of governments. Chenery¹⁰⁷ and Linder argue that it is not, for different reasons. Chapter Four below considers the point further. There it will be argued that a trade gap may arise in a growing economy even with optimum policy. It is not suggested that policy has in fact been optimum in any particular case, but only that the existence of a trade gap may not be attributed to bad policy without empirical evidence bearing directly on the particular case.

¹⁰⁷Op. cit., June 1969.

CHAPTER 3

RESTATEMENT OF THE THEORY

The purpose of this chapter is to restate the "two-gap" theory in algebraic terms, for the convenience of the reader, and in order to establish a terminology to which later chapters will refer. Its contents are expository and in no sense original. On the contrary, an attempt will be made to make the contents consistent with the common elements in previous statements of the theory.

The fundamental assumption of two-gap theory is that the capacity of a country to import goods and services is subject to a limit over which the country can have no control. (It does not follow that this limit is actually achieved in a particular case.) The capacity of the country to import goods and services will be denoted by M . Imports may play three roles. First, imports may be directly consumed. Second, with a given stock of capital goods (plant, equipment, and so forth), imports may be a variable input. It is assumed that a minimal quantity of variable input imports is required per unit of output. Denoting output by Y , and variable input imports (necessary consumption imports) by M_c ,

$$1. \quad M_c \geq bY, \quad 0 < b < 1$$

where b is a constant parameter. (In fact, if import substitution takes place, b would change over time; but it is given in the short

run, regardless of the level of production.) Finally, imports may be investment goods or consumers' goods. It is assumed that a minimum quantity of imported capital goods is required for every unit of investment which takes place, either for purpose of replacement or for purpose of expansion of the productive capacity. Thus

$$2. M_k \geq aI, 0 < a < 1,$$

where M_k is imports of capital goods and I is gross investment. The remainder of gross investment, above M_k , is made up of domestically produced capital goods.

A constant incremental capital-output ratio is assumed, so that the rate of growth of productive capacity depends upon net investment. Denoting current depreciation at replacement cost by D , and productive capacity by Y^* , its growth rate by G_{Y^*} and the incremental capital-output ratio by v ,

$$3. G_{Y^*} \leq \frac{1}{v} \frac{(I-D)}{Y^*} \leq \frac{1}{v} \frac{(M_k/a - D)}{Y^*}.$$

This constraint of the growth rate of productive capacity may or may not be effective. First, a closed economy would face an additional limit with respect to finance. If the proportion of income saved is s , this limit would be expressed by the familiar equation

$$4. G_{Y^*} \leq \frac{s}{v}.$$

Finally, limits in the supply of skilled labor, bottlenecks, failures of information and limits of entrepreneurship may limit the rate at which capital can be absorbed, and thus, the rate of growth of the productive capacity.

$$5. G_{Y^*} \leq \bar{G}$$

In case

$$6. \frac{1}{v} \frac{(M_k/a - D)}{Y^*} \leq \bar{G},$$

the limit of investment will be set by inequality 2., that is, by imports of capital goods, even if the supply of saving is unlimited.

If in addition,

$$7. \frac{1}{v} \frac{(M_k/a - D)}{Y^*} \leq \frac{s}{v},$$

that is,

$$8. \frac{(M_k/a - D)}{Y^*} \leq s,$$

then the growth of productive capacity is strictly limited by imported capital goods and moreover, some domestic saving is either wasted or frustrated.

Since

$$9. M_k \leq M - M_c \leq M - bY,$$

Y cannot grow at a rate greater than the rate of growth of imports without bringing about a situation like that of inequality 8., if b is constant over time. In fact, b will be constant over time if there is not import substitution. Thus, more fully, Y cannot grow indefinitely at a rate greater than the rate of growth of imports, except to the extent that the excess is offset by import substitution.

Two things ought to be said before this brief chapter is concluded.

First, the assumption that the rate of growth of the capacity

to import is beyond the control of government policy might be disputed. It may be supported, however, in one of two ways. First, one might assert that there must be a limit of some kind, regardless of how good policy may be. Governments are not omnipotent, whatever economists or governors may imagine to the contrary. This is not very satisfactory, though. It is conceptually possible that a country might export its entire product, and that at a good price. Certainly, that country would face a limited capacity to import. The limit would not be relevant to the two-gap theory, however. Second, as regards the traditional exports of an underdeveloped country, some limits of a more relevant kind do clearly exist. They depend upon the growth of income in the importing country and on the price and income elasticity of demand for the traditional imports. The next chapter will develop this point at greater length.¹ However, one may ask, what is to prevent underdeveloped countries from exporting novel goods?

First, new exports may face insuperable protectionist barriers in those countries which have the means to buy. Second, it may be that there are no novel exports which would pay. As Linder points out,² new exports may not yield subsistence factor payments when sold at market clearing world prices. In particular, it may be that there is no novel export industry which would yield more imports than it would require, by reason of the low absolute productivity of the

¹See pp. 76 - 80 below.

²Trade and Trade Policy for Development (New York: Praeger, 1967).

underdeveloped country. There is some evidence³ that factor productivity varies considerably more between countries for some sectors than it does for others. Such variations may be inherent in industrial technology, and may account in part for the difficulty of introducing new sectors, apart from Linder's representative demand hypothesis. It may be that investment, research, and "learning by doing"⁴ are required to raise the level of productivity before the new sectors would even be feasible. However, investment requires imports and "learning by doing" requires either investment or ongoing production. Here is another vicious circle.

Second, the identity of "input imports" may not be obvious prima facie. Consumption goods may in effect be "input imports" for two reasons. First, in countries which are not self-sufficient in terms of foodstuffs, imports of foodstuffs may increase efficiency by raising nutritional standards.⁵ Second, a certain amount of consumption imports of other kinds may be required in order to maintain incentives to work. Employment for money wages may be an unattractive

³K. Arrow, H. Chenery, Minhas, R. Solow, "Capital-Labor Substitution and Economic Efficiency," Review of Economics and Statistics, XLIII, 3 (Aug. 1961), pp. 225-50; F. Gehrels, "Factor Efficiency, Substitution, and the Basis for Trade; Some Empirical Evidence," Kyklos, XXIII, Fasc. 2 (1970), pp. 279-302.

⁴K. Arrow, "Economic Implications of Learning by Doing," Review of Economics Studies, XXX, 4 (Oct. 1968), pp. 167-68. See Ch. 4, Appendix 2, below.

⁵See B. Higgins, Economic Development, Rev. Ed. (New York: Norton, 1968), pp. 320-325; Y. S. Cho, Disguised Unemployment in Underdeveloped Countries, with special reference to South Korean Agriculture (Berkeley, 1963).

alternate to traditional pursuits if the money wages will buy nothing which cannot be obtained through those traditional pursuits.⁶ Thus the reducible margin of nonnecessary imports may be significantly less than it would appear at the first glance.

⁶See B. Higgins, op. cit., pp. 233-35.

CHAPTER 4

THE EMERGENCE OF THE TRADE GAP

The literature on trade-constrained growth portrays an example of circular causation. It is flawed by the general failure to explain how it is that the shortage of imported capital goods and its attendant inflexibility and trade dependency might arise in a flexible, developing country. Thus it remains vulnerable to criticism such as that of Bruton,¹ that it in fact arose through poor government policy and could be reversed through appropriate policy.

This chapter considers how a trade gap might arise in a country which exports a single good and requires an imported capital good. The model is then reconsidered in the light of more realistic assumptions. It is argued that in either case, the country will experience a spiral of increasing relative scarcity of imported capital goods (and consequently of other imports as well), exchange depreciation, and deterioration of the terms of trade, until either the country ceases to use the imported capital good or it uses it to the minimum degree which is technologically feasible, and hence faces a strict import minimum in point of capital goods, and thus again consequently, in terms of all imports. In other words, dependency on the

¹H. Bruton, "The Two Gap Approach to Aid and Development: Comment," American Economic Review, 61X, 3 (June, 1969), pp. 439-446.

importation of some capital goods can be the cause of the trade gap. Of course, it is not known whether it is the historical cause in any particular case.

For simplicity, this chapter abstracts from import substitution in capital goods. That is, the imported capital good, which is in actual fact an aggregate of imported capital goods, is supposed to have a homogenous character over time. A capital good imported at the outset continues to be imported and thus to be a part of the category "imported capital goods." Certainly ongoing import substitution in capital goods would modify the results. Moreover, a country which is capable of achieving self-sufficiency in terms of capital goods is evidently immune to a trade gap in the long run.

It is also assumed that a demand curve can be defined for a country's "exports." This is clearly true if the country is limited to some specified range of export goods. It is not clearly false if the country is not so limited. For any consistent array of government policies, a shifting demand curve for the goods actually exported, over time can be defined. It seems likely on the face of it that the set of all such demand curves has an upper envelope. If the quantity of exports demanded in the case of each shifting demand curve is defined so as to be net of the import inputs required to produce the quantity of exports, then the upper envelope curve will correspond, for each time period and each hypothetical exchange rate, to the optimum policies. The upper envelope would be a shifting export demand curve which would be policy-free, since it would assume optimum policies at every point. Moreover, the upper envelope of a finite

array of downward-sloping curves would be downward sloping, since each of its segments would correspond to a segment of one or another of the original curves.

This chapter contains a minimally mathematical exposition of the argument with respect to the emergence of the trade gap. Appendix One contains the mathematical justification of it.

This chapter abstracts from technological progress. Unless technological progress should have the happy property of augmenting or saving imported capital goods, it would probably not change the argument. However, Appendix Two relates some recent conceptions of technological progress to underdeveloped countries, and to some extent justifies the neglect of technical progress here.

Consider a "model" country which produces just two outputs, "domestic capital goods" and "exports," using two inputs, "domestic capital goods," and "imported capital goods." Suppose for the present that the demand for its exports is stationary and of constant elasticity. Returns to scale in the export industry are either constant or diminishing. (Since both land and labor have been left out of account, diminishing returns to scale may represent the more plausible condition.) The elasticity of demand is finite. In a given year, the output of "domestic capital goods" is allocated between the two sectors in some proportion and invested, while the export goods are traded for "imported capital goods," which are likewise allocated between the two sectors and invested. Suppose that the quantity of capital goods of each kind in use in the export sector is increased by one percent. Then the output of export goods is increased by one percent (in the case of constant returns to scale)

or less (in the case of diminishing returns to scale). The increase in output of export goods will in any case depress the price of export goods, so that export revenues and the capacity to import will increase by less than one percent. Balanced growth proves impossible because a one percent increase in the imported capital goods, allocated according to a given proportionate rule, fails to procure a further one percent increase in the imported capital goods available.

One of two things must occur: 1) imported capital goods grow proportionately scarce, or 2) the domestic capital of the export sector must increase at a greater rate than does the imported capital, so as to maintain the growth rate of imported capital goods. But these "two" occurrences are identical!

With increasing relative scarcity, the price of imported capital goods must rise. In the model economy, this means an exchange depreciation and a deterioration in the terms of trade. So it does in a more realistic model, a point which will be further considered below.

Thus, the country's relative stock of imported capital goods will decline, and its terms of trade deteriorate, until one of two things occurs. First, the price of imported capital goods may rise relative to domestically produced capital goods to the point that the former are no longer used, presuming that production can go on without a minimum proportion of imported capital goods to output. Balanced growth can then, one presumes, occur. Alternatively, if a minimum quantity of imported capital goods per unit of output is required (and henceforth it will be assumed that this is so) then that minimum will be attained eventually, and then imported capital goods will be a bottleneck constraint of further growth. This is the

trade gap. Figures 1., 2., and 3. illustrate isoquant maps which display such limits.²

Returns to scale in the domestic capital sector make no difference. This is clear if one looks at the model in a slightly different way. In order to transform one unit of domestically produced capital goods into one unit of imported capital goods, the country must first shift resources from the domestic capital goods industry to the export industry, and then trade the increase in export goods for nondomestically produced capital goods. As the export sector expands relative to its demand (and possibly relative to its supplies of limited inputs) the marginal rate of transformation grows more and more disadvantageous with respect to imported capital goods. As figure 4 shows, the result is that domestic capital goods are substituted for imported capital goods so long as this can be done with positive marginal product. There, curves BB' and EE' represent the transformation frontier vis-a-vis domestic capital goods and imported capital goods. (The curvature reflects diminishing returns to scale in the export sector, finitely elastic demand for exports, or both.) When the possibilities of such substitution are exhausted, however, the country finds itself in a "trade gap." This has occurred by point A in figure 4.

The assumption of unchanging demand made above may seem

²In the case of the constant elasticity of substitution (CES) production function, with the elasticity of substitution less than one, the proportion of either input to the output approaches its lower bound only asymptotically, never actually reaching it. In that case, the bottleneck or trade gap never actually occurs, but is approximated within any meaningful limits, within a finite and determinate time.

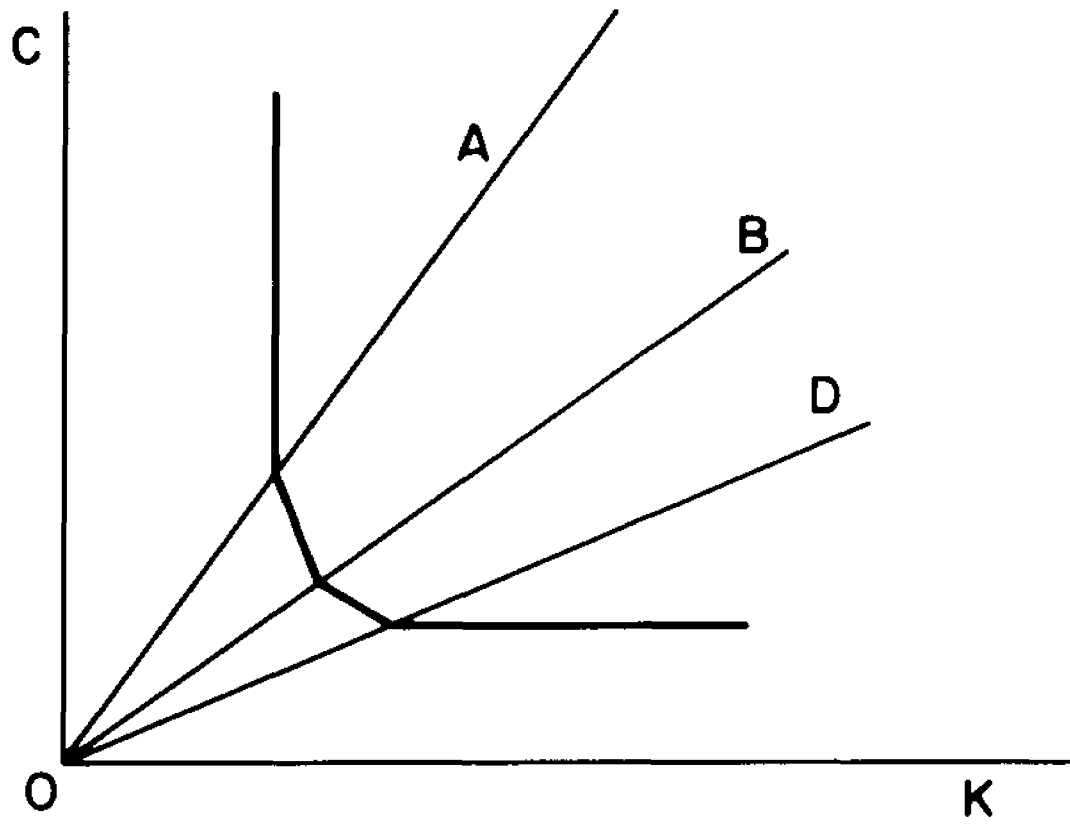


Figure 1

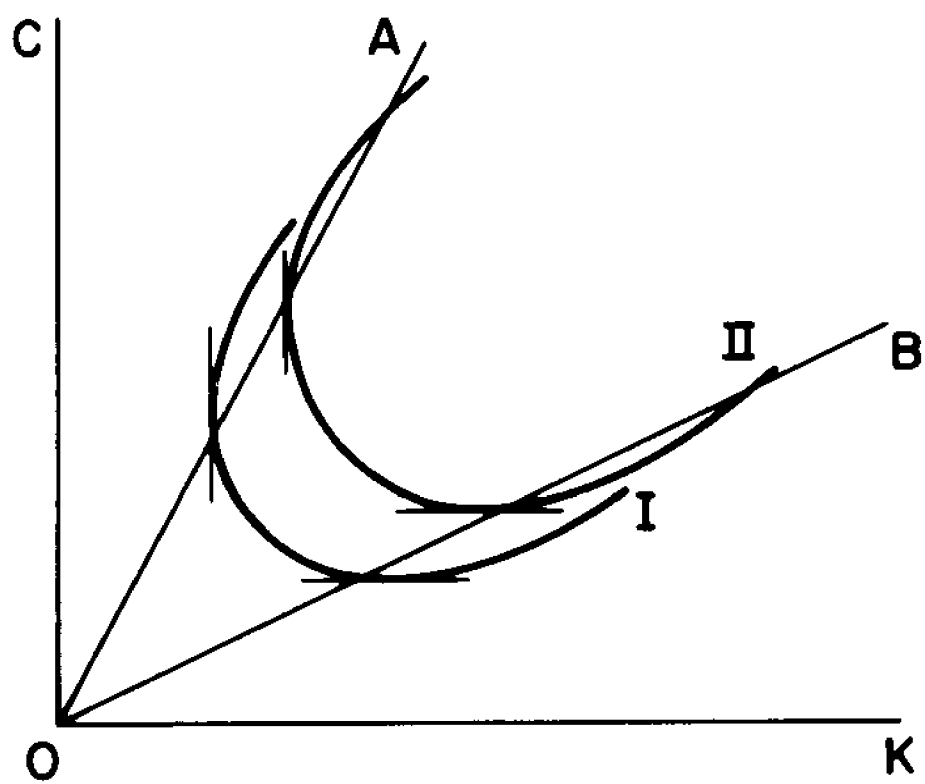


Figure 2

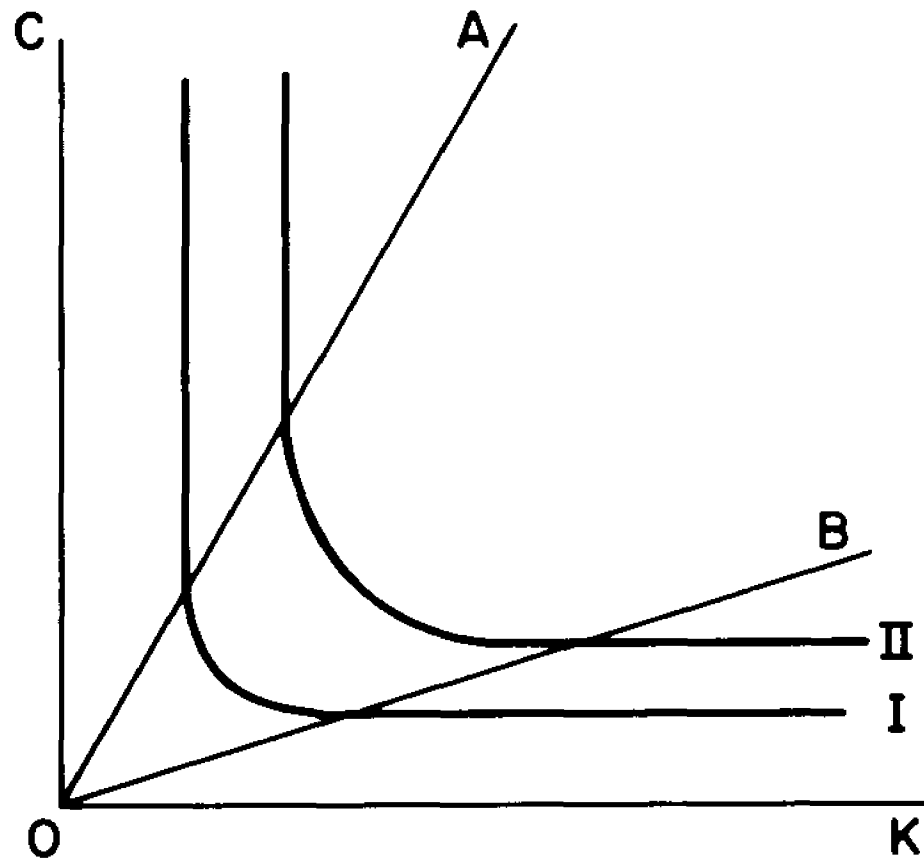


Figure 3

implausible. If it is relaxed, the results given above may, of course, have to be modified. Increasing demand for the products of the country will certainly slow the process by which the trade gap emerges, and will permit some growth of the country even if the export sector is not expanded at all. If the demand for exports increases rapidly enough, the process described above will be reversed. Indeed, if there are given limits to the growth of the domestic capital goods sector³ the opposite problem, a chronic shortage of domestically produced capital goods, is possible. Libya,⁴ with its petroleum exports, is probably an example of a country in such a situation.

³If skills, education, and research are outputs of the domestic capital sector, then the limit imposed by the growth of the domestic capital sector is the limit of absorption as the term is used by Chenery and Bruno (*op. cit.*) but evidently not as used by Horvat ("The Rule of Accumulation in a Planned Economy," *Kyklos*, XXI fasc. 2, p. 239, 1968). Moreover, the domestic capital sector is one of the two sectors in Feld'man-Mahalanobis models of growth and planning. Literature on this topic is scarce, but one may cite G. A. Feld'man "On the Theory of Rates of Growth of National Income," *Planvoe Khozhaistvo*, No. 11 (Nov. 1928) and No. 12 (Dec. 1928). This has been translated but the translation (of Fakiolas and Yanovsky) is evidently not published. Bhalla refers to it in "From Feld'man to Mahalanobis in Economic Planning," *Kyklos*, XVIII, fasc. 1 (1965), pp. 9-24. Mahalanobis' exposition is An Approach of Operational Research to Planning in India, (London: Asia Publishing House, 1963). Bhalla's article is most useful, for its parallel of Feld'man and Mahalanobis and its assessment of the shortcomings of the Feld'man model even in the Soviet context. Domar has also studied the Feld'man model (Essays in the Theory of Economic Growth, "A Soviet Model of Growth").

It seems worth remarking that Feld'man's model is the first "Harrod-Domar" model known in the literature, though it goes beyond the Harrod-Domar framework; and that Mahalanobis' development of a similar model was independent.

⁴As Higgins describes it in Economic Development, Rev. Ed. (New York: Norton, 1968), Ch. 35, Libya's growth, outside the oil sector, is limited to about 3% due to a skill bottleneck. It is of interest that, as Higgins remarks, the entrepreneurship "bottleneck" evaporated in Libya as domestic entrepreneurs responded to clear opportunities for profit in the wake [or as may be more appropriate, the flood] of oil growth. (p. 824).

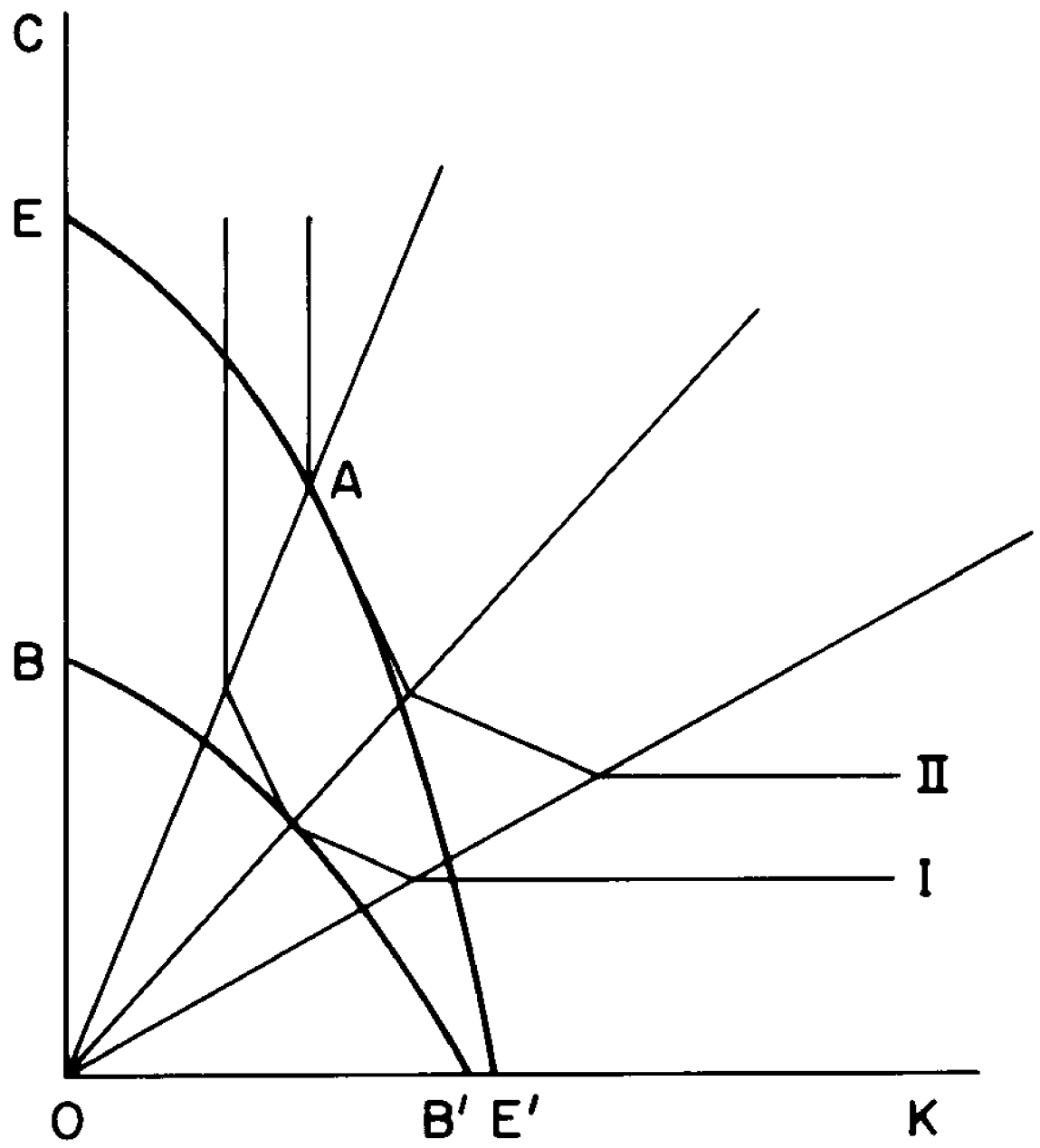


Figure 4

A mathematical investigation reveals that there is just one rate of growth which is consistent with a balanced use of domestic and imported capital goods. It is

$$1. \quad G_C^* = \frac{r}{(u+1)(g_C+g_K)-1} \cdot \frac{u(1-g_K)-g_K}{u(1-g_K)-1} \quad ^5$$

In equation 1, r is the rate of growth of the demand for exports and u is the elasticity of demand for exports. The parameters g_K and g_C are the elasticities of output with respect to imported and domestic capital, respectively in the export sector. To explain them requires a digression. Here and in what follows, C denotes domestic capital goods used in the export sector and K denotes imported capital goods used in the export sector. Suppose a small addition is made to the stock of imported capital goods in use in the export sector. The addition is denoted by ΔC . The stock of domestic capital goods in the export sector is held constant but the quantities of capital and labor are allowed to vary mutatis mutandis. An increment of the output of the export sector results. Denoting the output of the export sector by E and the increment of that output by ΔE , g_K is approximately $\frac{K\Delta E}{E\Delta K}$. (It would be the limit of $\frac{K\Delta E}{E\Delta K}$ as ΔK approaches zero.) The term g_C is defined for a similar variation of C .

The sum of g_K+g_C expresses the elasticity of export sector output with respect to capital goods of both kinds in given proportions. If there are constant returns to scale in the export sector and land and labor are available to the export sector in

⁵See Appendix 1.

unlimited quantities at a fixed price and homogenous quality,⁶

$g_C + g_K = 1$. If either there are diminishing returns to scale in the export sector, or land and/or labor can be brought into the export sector only at rising cost or with diminishing productivity, or both, $g_C + g_K$

1. Thus in some sense, denoting

$$2. \quad Z = \frac{1}{(u+1)(g_C + g_K) - 1}$$

Z expresses the effects of returns to scale on the limiting rate of growth of the domestic capital stock, G_C^* .

Denoting

$$3. \quad X = \frac{u(1-g_K) - g_K}{u(1-g_K) - 1}$$

X represents the effects of the elasticity of demand for exports as it interacts with the productivity of imported capital goods in the export sector. Notice that as u increases without bound (approaching infinite elasticity of demand), X approaches one in the limit. As u approaches one, X approaches $\frac{1}{2-g_K}$, which is less than one. As u approaches zero, X approaches g_K . As g_K approaches 1, X approaches 1. In the trade gap case, $g_K = 1$ and hence so does X . Further, in that case $g_C = 0$ and Z is also one.

Now, suppose that a country grows at a rate above G_C^* . The higher growth rate may be the one dictated by saving considerations and those of the overall productivity of capital goods; may be the natural rate of growth in the light of the increase of the labor

⁶This "unlimited supplies of labor" (and land) hypothesis may be valid if the export sector is very small relative to the economy. This will probably rarely be true.

force and its increasing efficiency due to technological progress and learning by doing; and may be warranted by the expectations of investors. Notwithstanding it will not be a balanced growth rate. G_C , the growth rate of domestically produced capital goods, will be greater than the growth rate of investment, output, and labor in efficiency terms. G_K , the growth rate of imported capital, will be less. $\frac{C}{K}$ will tend to increase. If the marginal product of domestic capital approaches zero in the limit, the rate of increase of $\frac{C}{K}$ will actually increase. If there is an upward limit of $\frac{C}{K}$, it will be reached within a determinate time period.

Some selected values of X and Z are given in Tables one and two. The effects of diminishing returns to scale are greater with greater elasticity of demand, and are quite substantial even for such moderately decreasing returns as 5%. Thus, a country with an export sector which comprises a major part of its economy, which is localized or specialized or both, or which is dependent on specialized land or labor in limited supply; and the product of which is in moderate to elastic demand, may be limited to a very low rate of growth indeed relative to the rate of growth of exports. For example, with $g_C + g_K = .8$ and $u = -20$, balanced growth could be at only 21% of the rate of growth of demand for exports. On the other hand, the values of X are smaller for less elastic demand.

In any case, $G_C^* < r$, unless $g_C + g_K > \frac{u}{u+1}$. For $u < -1$, this would require increasing returns to scale in the export sector, possibly at several hundred percent or more in elasticity terms. This seems wholly implausible. On the other hand, if $u > -1$, the country can

TABLE 1

$$\frac{u(1-g_K)-g_K}{u(1-g_K)-1}$$

g_K	-50	-20	-10^u	-5	-3	-2
.1	.98	.95	.91	.84	.75	.68
.3	.96	.95	.91	.84	.77	.63
.5	.98	.95	.92	.86	.80	.75
.7	.98	.96	.93	.89	.83	.81
.9	.98	.97	.95	.93	.92	.92

TABLE 2

$$\frac{1}{(u+1)(g_C+g_K)-1}$$

	u=	-50	-20	-10	-2
$g_C+g_K=$.99	.66	.84	.92	.99
	.95	.29	.41	.70	.95
	.90	.17	.34	.53	.91
	.80	.09	.21	.36	.83
	.50	.04	.06	.18	.67

expand its capacity to import by acting as a monopolist and decreasing the output of its export sector. It seems implausible that gains of this kind are unlimited, however.

The rate of increase of C/K will depend upon G_C , r , u , g_C , and g_K . in general. Equation 1. above is derived from

$$4. \quad G_K = \left[\frac{g_C}{\frac{u}{u+1} - g_K} \right] \cdot G_C \frac{r}{(1-g_K)} \quad ^7$$

from which follows

$$5. \quad \frac{G_C}{\frac{C}{K}} = \left[\frac{g_C}{\frac{u}{u+1} - g_K} - 1 \right] G_C - \frac{r}{(1-g_K)-1}.$$

Several values of $\frac{G_C}{\frac{C}{K}}$ computed for hypothetical values of the other variables are given in Table Three. They vary from quite negligible to quite respectable figures. Moreover, $\frac{G_C}{\frac{C}{K}}$ increases more than proportionately with G_C .

Now it is necessary to reconsider some of the more unrealistic assumptions of the model. First, consider the exclusion of consumption goods. All countries produce consumption goods, and an irreducible minimum import content of consumption (and other domestic economic activity) is an assumption of most "two-gap" models.

Suppose that the country both produces and imports consumption goods, and that the elasticity of demand for imported consumers' goods is, at the outset, not zero. Then, as imported goods grow

⁷See Appendix 1.

TABLE 3

$$G_C = 0.08$$

g_C	g_K	u	r	$\frac{G_C}{K}$
.75	.25	-50	.05	0.00082
.25	.75	-50	.05	0.002334
.25	.75	-5	.05	0.001778
.2	.7	-5	.05	0.030909
.1	.6	-5	.05	0.055047
.1	.6	-5	.00	0.069333

more scarce, their price ought to rise relative not only to domestic capital goods, but to consumers' goods. If the relative prices of imported capital goods and imported consumers' goods are determined in world markets, and thus given to the country, the price of imported capital goods can rise only as a result of exchange depreciation. This rise in the price of all imports will result in a decrease in the proportion of imports which are consumers' goods, so that the stock of imported capital goods grows more rapidly, both absolutely and relatively, than would be the case otherwise. However, there is in any case a limit to this process. Consumers' goods imports too have an irreducible minimum.

It may be zero,⁸ but it is more probably positive. Thus imported consumers' goods as well as imported capital goods become chronically scarce, the terms of trade deteriorate, and the country moves into a trade gap, as before.⁹

No mention has been made thus far of any saving limit. Rather it has been assumed that all capital goods which can be procured are in fact deployed to investment. The imposition of a saving limit has two effects. One is this: as the domestic capital stock grows relatively to the stock of imported capital goods, its marginal product would decline in relative terms, and the proportion of total new investment of both types which goes to the domestic capital goods sector would decrease, other things being equal. The proportion of total investment going to the export sector would increase. Thus the stock of imported capital goods would grow a bit more rapidly than equation 4. indicates. However, the impact of this shift of deployment of resources must eventually decline. The rate of increase of the proportion of all investment going to the export sector must approach zero, since that proportion clearly cannot be greater than one. If the proportion should increase at a positive rate indefinitely it would surpass any finite limit.

One is a finite limit.

The importance of this qualification depends somewhat on the

⁸It cannot be less than zero. The possibility of adding novel export goods has already been dealt with, and is presumed to be a determinant of the demand curve of exports.

⁹Of course, exchange controls or currency over-valuation can arrest this process, but this merely shifts the shortage from one (goods) market to another (money) market.

initial magnitude of the domestic capital goods sector by comparison with the export sector. If the export sector is very small by comparison with the domestic capital goods sector, then a high rate of growth of imported capital can be sustained for some time by redeployment of investment. If the export sector is already large relative to the capital goods sector, the movement toward the trade gap can be only slightly postponed in this way.

It appears that in a wide variety of cases the growth of the country at the maximum attainable rate, or, indeed, at a rate of growth consistent with full use of its resources with a high rate of saving, will precipitate the country into a chronic shortage of imported capital goods. Chapters Two and Three have considered the results of such a shortage.

On the other hand, if G_C^* is large, it may be that the country cannot attain the balance growth rate. In that case, $\frac{C}{K}$ will diminish until the lower limit is reached, and will then find its growth limited by the growth of its domestic capital stock. This would occur when r is quite large; the export sector is quite small relative to the total economy and uses unspecialized factors of production which are available from other sectors at virtually constant subsistence rates and in virtually unlimited supply; returns to scale in the export industry are constant; large quantities of imported capital goods of high marginal productivity are used in the export sector (so that $g_K \frac{K\Delta E}{E\Delta K}$ is large) and the demand for the product of the export sector is inelastic.

If the term "domestic capital goods" is interpreted broadly,

so as to include entrepreneurial efficiency and the increase in the efficiency of labor through "learning by doing," the limit to growth imposed by a chronic shortage of domestically produced capital goods would seem to be essentially the limit of the capacity of the economy to absorb (imported or financial) capital as described by Chenery, et al. Although it undoubtedly implies a higher growth rate, this limit, like the trade limit, makes internal and domestic balance impossible simultaneously.

Thus, it is not enough just that G_C be less than or equal to G_C^* . In fact, it must be equal, if balanced growth is to occur. In any other case, the country is eventually caught in a spiral of imbalance among the different capital goods which are imported and which are domestically produced. Any country which requires both imported and domestically produced capital goods for growth must either grow at a particular rate, determined by trade conditions, or tend in the direction of a factor-proportions problem of one kind or the other. It is not clear that there is any force which moves the country toward that particular rate, nor is it clear that it is desirable that the country should grow at that particular rate. It would appear that a factor imbalance of one sort or the other is to be expected in such a country.

Indeed, a country might pass through successive stages in which imbalances of different sorts prevail. Suppose that a country has a self-sufficient agrarian economy when either 1) new natural resources are discovered within its borders, which are in rapidly increasing demand in the industrial countries; or 2) one of its

traditional products or a newly introduced product finds a new market, characterized by rapidly increasing and inelastic demand, in the industrialized countries. Initially the country experiences a strong pressure toward increasing $\frac{C}{K}$, and eventually makes maximal use of imported capital goods. Competing domestic cottage industry may be extinguished during this period. Finally, however, the new export industry reaches the limits of the natural resources or land which is peculiarly adapted to it, or the limits of the supply of labor; and/or the market for the export good in the industrialized countries approaches its limits so that G_C^* decreases to below the rate of growth that the country does in fact attain. The country now begins a period of increasing $\frac{C}{K}$. It may take some time. A transitional period is to be expected in which growth is fairly high, but declining, and domestic and external balance are both possible simultaneously (so that "classical" economic policies are workable). Finally, however, the trade gap develops as a third stage of underdevelopment. This sequence is, of course, purely hypothetical; yet it appears plausible in the light of the theory presented above.

In any case, if a country is dependent on imports for a major proportion of its investment goods, a factor-proportion problem may arise. In general a tendency to factor imbalance is to be expected. International capital flows have been abstracted from here, since the purpose has been to explain the forces that underlie them. It may be that capital flows can fill the gap, if indeed a gap exists. These are questions for empirical analysis, and later chapters will

be directed toward the question whether the Latin American countries have experienced a trade gap. Before turning to that problem, however, some of the policy implications of a hypothetical trade gap will be explored in the next chapter.

APPENDIX I. THE MATHEMATICAL MODEL OF A GROWING ECONOMY WITH TWO CAPITAL GOODS, ONE OF WHICH IS IMPORTED

Consider a model economy which produces three commodities, domestic capital, exports, and consumption goods, using two inputs, domestic and imported capital goods. Since only the domestic capital goods and export industries are relevant to the process of capital accumulation, only their production functions need be considered.

They are

$$1. Y_d = f(C_d, K_d)$$

$$2. Y_e = g(C_e, K_e)$$

where

Y_d is the output of domestic capital goods,

Y_e is the output of export goods,

C_d is domestic capital employed in the domestic capital sector,

C_e is domestic capital employed in the export sector,

K_d is imported capital employed in the domestic capital sector,

K_e is imported capital employed in the export sector,

f, g are unspecified functions with the usual properties of production functions.

All exports are, one assumes, exported. A fixed proportion of imports, α , are imported capital goods. The price of exports is, for convenience, expressed in terms of imported capital goods. It is

denoted by p . The proportion of all domestic capital formation which occurs in the domestic capital sector is b_d , a constant; the proportion of all imported capital formation which occurs in the domestic capital sector is c_d , also constant. The corresponding parameters for the export sector are b_e , c_e . (The constance of a , b_d , c_d , b_e , c_e will be reconsidered later on.) Note that $b_d + b_e \leq 1$, $c_d + c_e \leq 1$. It is assumed that there is no saving limit on capital formation, that is, the formation of domestic capital in a given period is by assumption equal to the output of the domestic capital sector in that period, and the formation of imported capital in a given period is by assumption equal to the importation of capital goods in that period. Moreover, the domestic capital and export sectors are assumed to operate at full capacity.

$$f_C = \frac{\partial Y_d C_d}{\partial C_d Y_d}^1$$

$$f_K = \frac{\partial Y_d K_d}{\partial C_d Y_d}$$

$$g_C = \frac{\partial Y_e C_e}{\partial C_e Y_e}$$

$$g_K = \frac{\partial Y_e K_e}{\partial C_e Y_e}$$

¹Clearly, the elasticities used will not be constant over time, since the production functions cannot be of the Cobb-Douglas form. (see note 3, p. 11, below.) However, differences in their magnitude do not effect the results significantly unless they approximate zero, at which point (in the case of f_C , g_C) the marginal product of domestic capital approximates zero, Q.E.D. Hence they will be treated as constants herein, for convenience.

$G_{Y_d} = \frac{\frac{dY_d}{dt}}{Y_d}$, and similarly, G subscripted by any variable x , that is, G_x , denotes the growth rate of x .

$$C = C_d + C_e$$

$$K = K_d + K_e$$

G_{Y_d} is the growth rate of domestic capital formation, that is, of $\frac{dC}{dt}$. Thus G_{Y_d} is also the rate of growth of domestic capital formation in the domestic capital and export sectors, since those quantities, $\frac{dC_d}{dt}$ and $\frac{dC_e}{dt}$, differ from $\frac{dC}{dt}$ by constants. If the rate of growth of domestic capital formation, in either sector, remains constant, the rate of growth of the stock of domestic capital in that sector will tend to the same level in the limit. Likewise, the growth rate of the stock of imported capital in each of the two sectors approaches the growth rate of the formation of imported capital, i.e. of the importation of capital goods. This latter depends on the growth rate of the export sector and on the demand for exports.

In dealing with growth rates, it is convenient to assume that the elasticity of demand is constant, as with a log-linear demand function. However, it may be implausible that demand is constant over time. Thus, in addition to shifts in quantity demanded induced by changes in price, autonomous changes in demand are to be expected with growth in world income, the development of new

substitute products and the emergence of new rivals in the production of a particular country's traditional exports. Again it is convenient, in dealing with growth rates, to assume a constant rate of shift of demand, in logarithmic terms. A demand function embodying these assumptions may be written as follows:

$$3. \quad q_d = Ae^{rt} p^u, \quad u < 0.$$

Here r is the constant geometrical rate of growth or decline of quantity demanded with any given price, u is the elasticity of demand, t denotes time, and A is a constant of integration. The exponents r and u are parameters of the model. Of course, q_d is the output of the export sector. Y_e , which has by assumption no alternative outlet for its product, and which is determined by the inputs of the export sector as in Equation 2, above. Hence in this case price, not quantity demanded is the dependent variable, and 3. may be rewritten,

$$4. \quad p = \frac{e^{-rt} Y_e^{\frac{1}{u}}}{A}.$$

Now,

$$5. \quad \frac{dK}{dt} = \alpha p Y_e,$$

so that

$$6. \quad G_{\frac{dK}{dt}} = G_{\alpha} + G_p + G_{Y_e} = G_p + G_{Y_e};$$

since $G_{\alpha} = 0$ by assumption. It follows that

$$7. \quad G_K = G_{K_d} = G_{K_e} + G_p + G_{Y_e}$$

The growth rate of the export-revenue of the country defines the limit of the growth rate of its stock of imported capital, and thus of each of its two components.

Now,

$$8. \quad G_p = \frac{1}{u}(G_{Y_e} - r)$$

so that

$$9. \quad G_{\frac{dK}{dt}} = (1 + \frac{1}{u})G_{Y_e} - \frac{r}{u}.$$

This equation resembles a familiar formula of microeconomics.²

Notice that u is negative, so, if it is finite, $1 + \frac{1}{u}$ is less than one and $\frac{r}{u}$ is positive.

²_{i.e.}

$$1. \quad MR = p(\frac{1}{u} + 1) \text{ for a stationary demand curve, that is, } r = 0.$$

Here

$$2. \quad G_{\frac{dK}{dt}} = \frac{\frac{dP \cdot Y_e}{dt}}{P \cdot Y_e} = \frac{\frac{\partial P \cdot Y_e}{\partial Y_e}}{P} \cdot \frac{dY_e}{dt}$$

Since $MR = \frac{\partial P \cdot Y_e}{\partial Y_e}$, 2. is

$$3. \quad G_{\frac{dK}{dt}} = \frac{MR}{P} \cdot G_{Y_e},$$

that is

$$4. \quad G_{\frac{dK}{dt}} = (1 + \frac{1}{u})G_{Y_e}.$$

Expression 8. above is the more general form.

It now follows³ that

$$10. \quad G_K \approx \frac{\frac{g_C}{1 + \frac{1}{u}} - g_K}{1} G_C - \frac{r}{(1-g_K)u - 1}.$$

To show the significance of this point, assume that $r = 0$, and that g has constant or decreasing returns to scale and $u < -1$. Then $g_C \leq 1 - g_K$, so that

$$\frac{\frac{g_C}{1 + \frac{1}{u}} - g_K}{1 + \frac{1}{u} - g_K} < \frac{1 - g_K}{1 + \frac{1}{u} - g_K} < 1.$$

since $\frac{1}{1 + \frac{1}{u}} > 1$. It follows that $G_K < G_C$ by a constant factor, so

$G_C - G_K$, the growth rate of $\frac{C}{K}$, is a positive constant. That being so, $\frac{C}{K}$ will increase beyond any finite bound in a determinate period of time. In other words the proportion of domestic capital to imported

³Since $G_K \rightarrow G_{\frac{dK}{dt}}$,

$$1. \quad G_K \approx (1 + \frac{1}{u})G_{Y_e} - \frac{r}{u} \text{ and}$$

$$2. \quad G_{Y_e} = g_C G_C + g_K G_K, \text{ so}$$

$$3. \quad G_K \approx (1 + \frac{1}{u})(g_C G_C + g_K G_K) - \frac{r}{u}$$

That is

$$4. \quad (1 - (1 + \frac{1}{u})g_K)G_K \approx (1 + \frac{1}{u})g_C G_C - \frac{r}{u};$$

whence

$$5. \quad G_K \approx \frac{(1 + \frac{1}{u})}{1 - (1 + \frac{1}{u})g_K} g_C G_C - \frac{r}{u(1 - (1 + \frac{1}{u})g_K)}.$$

Simplifying gives 10. in the text.

capital will increase without limit, which this section was to demonstrate. More correctly, though, g_C cannot be constant if there is an upward limit of $\frac{C}{K}$, but rather it must approach zero in the limit. Thus in point of fact, $\frac{C}{K}$ increases at an increasing rate.

There are a number of cases to be considered,⁴ but, in general,

$$^4 \quad 1) \text{ if } u > -1, G_C > 0 \text{ implies } G_K < 0$$

$$2) \text{ if } u < -1$$

$$G_C > \frac{r}{(u+1)(g_C+g_K) - u} \cdot \frac{u(1-g_K)-g_K}{u(1-g_K)-1}$$

$$\text{implies } G_K > G_C$$

$$\text{if } g_C+g_K < \frac{u}{u+1}$$

$$\text{and implies } G_K > G_C$$

$$\text{if } g_C + g_K > \frac{u}{u+1}$$

This last implies increasing returns to scale, possibly at quite a large rate, and thus seems irrelevant in practice. With constant returns to scale, 2) is

$$3) \quad G_C > r \frac{u(1-g_K)-g_K}{u(1-g_K)-1}$$

This awkward term is always less than r , since u is negative. It approaches r in the limit as u approaches minus infinity and it approaches $-4(g_K-2)$, a positive term less than r , as u approaches -1 .

Thus it would appear that even with constant returns to scale in the export sector, a country's capital stock cannot grow indefinitely even at a rate equal to the rate of growth of its exports, without unbalancing its capital stock in the direction of domestically produced capital goods.

In this context, "constant returns to scale" means constant returns to capital goods, since land and labor variables have been suppressed. Section Three will explore the significance of this point, but notice that if $g_K+g_C < 1$,

$G_C > G_K$ is to be expected accordingly as

$$11. \quad G_C < \frac{r}{(u+1)(g_C+g_K)-u} \cdot \frac{u(1-g_K)-g_K}{u(1-g_K)-1} < r.$$

This model posits several assumptions which are more convenient than plausible. The remainder of this section will investigate in a less systematic way the effect of relaxing some of these assumptions.

It was assumed that no land and labor inputs were involved. However, such inputs are required and if the expansion of the domestic capital and export sectors results in increasing prices of land and labor, the functions f and g will display increasing costs, i.e., diminishing returns to scale, even if the "true" four-input production functions display constant returns to scale. Thus relaxation of that assumption makes it even more likely that the tendency to an increasing $\frac{C}{K}$ will be effective with a given positive r .

It was assumed that a fixed proportion of imports, α , was imported capital goods. In fact, of course, the relative supply of imported capital goods might be increased by increasing α . However, the growth rate of the stock of imported capital cannot be maintained by increasing α unless α has a positive, constant growth rate, as equation 6. indicates. However, if that were so, α would surpass any finite limit within a definite period. In particular, α would become greater than one. Since this clearly cannot be, the onset of

$$4) \quad \frac{1}{(u+1)(g_K+g_C)-1} < 1.$$

This term tends to zero as u approaches $-\infty$. Thus if returns to "scale" diminish, a wide variety of plausible values of g_K and u set the limit of balanced growth at a small fraction of the rate of growth of demand for exports.

the factor-proportions problem can only be postponed by increasing the proportion of imports which are capital goods.

The same comment applies, with qualification, to the constancy of b_d , b_e , c_d , and c_e . The qualification is this: if one of these four parameters has a negative constant growth rate, i.e., is subject exponential decay, its limit would be zero. This is clearly possible. Then equation 10. does not hold since $G_{C_d} = G_{C_e} = G_C$ and $G_{K_d} = G_{K_e} = G_K$ no longer hold. However, these possibilities do not alter the results of the previous section.⁵ This pertains, moreover, to the

⁵In this case, in place of equation 3 (footnote 3, page 92) we have

$$1. \quad G_K \approx (1 + \frac{1}{u}) [g_C(G_{b_e} + G_C) + g_K(G_{c_e} + G_K)] - \frac{r}{u},$$

from which, as in footnote 3,

$$2. \quad G_K \approx \frac{g_C G_C}{\frac{1}{1 + \frac{1}{u}} - g_K} - \frac{r}{(1 - g_K)u - 1} + \frac{g_C G_{b_e} + g_K G_{c_e}}{\frac{1}{1 + \frac{1}{u}} - g_K}$$

Now, let us suppress the change of demand for exports once again. If $r \leq 0$, G_K can be positive only if

$$3. \quad \frac{1}{\frac{1}{1 + \frac{1}{u}} - g_K} > 0.$$

Whenever that is so,

$$4. \quad \frac{g_C G_{b_e} + g_K G_{c_e}}{\frac{1}{1 + \frac{1}{u}} - g_K} < 0;$$

and may be deleted without changing the results of the previous section (indeed, the probability that those results will be meaningful with $r > 0$ is increased). Changes in the proportions going to other sectors are irrelevant in any case.

assumption of unlimited saving. The imposition of a saving constraint would require the allocation of scarce saving between the domestic capital sector and the export sector (and others). This would imply, in terms of the model, changes in the parameters b_d , b_e , c_d , and c_e . In particular, as the domestic capital stock grows relative to the imported capital stock, its marginal product would decline in relative terms, and the proportion of total new investment of both sorts in the domestic capital sector would diminish, other things being equal, while the proportion of total investment going to the export sector would increase. However, the terms G_{b_e} and G_{c_e} must in any case approach zero in the limit, while the magnitudes of the terms G_{b_d} and G_{c_d} are irrelevant to the model. In brief, the model pertains to the transformation of domestic capital goods into imported capital goods, and it applies virtually regardless of the circumstances surrounding the growth of the stock of domestic capital goods. Thus, a limit of total saving only postpones the onset of the factor-proportions problem.

APPENDIX II: RECENT MODELS OF TECHNOLOGICAL PROGRESS AND THE UNDERDEVELOPED COUNTRIES

The models developed in this chapter have not included technological progress as an explicit variable. The function of this appendix is to review three recent models of technological change in the light of their possible relevance to the problem of economic development.

One of the most fruitful recent innovations in the theory of innovations is the conception of technological progress as factor-augmenting. That is, it posits a production function of the form $Y = f(EK, FN)$ where Y is output, K is the stock of capital in use, N is the employed labor force, and E is the technological efficiency of capital and F the technological efficiency of labor. In this model, technological progress is conceived of as increasing E and F . There is no clear reason why technological progress should have that effect, but it is a simplifying assumption which, on the one hand, permits the use of a production function which is supposed to be stable over time, and, on the other hand, is not so clearly a contrived assumption as Harrod-neutrality,¹ for example. This scheme is usually connected with a production function having constant returns to scale and a constant elasticity of substitution.² In that

¹Technological progress is Harrod-neutral if it does not affect the relationship between the rate of return (the marginal product of capital) and the capital-output ratio. See Lectures in Dynamic Economics, Lect. I.

²Such a function takes the form

$$Y = a(bK^d + N^d)^{1/d}$$
 where Y is output, K is the stock of capital, N the labor force, and a , b , and d are arbitrary constants. See K. Arrow, H. Chenery, M. Minhas and R. Solow, "Capital-Labor Substitution and Economic Efficiency," Review of Economics and Statistics, XLIII, 3 (Aug. 1961), pp. 225-50.

context, balanced growth proves to be incompatible with a steady increase in E . On the other hand, if E is constant and technological progress takes the form of increasing F , then it is Harrod-neutral,³ and steady growth can occur.

A number of authors⁴ have made use of the innovation-possibility frontier, a construct independently proposed by Kennedy⁵ and von Weiszäcker (unpublished). It is assumed that there is a limited amount of resources to be devoted to augmenting capital and labor, and that for any given rate of labor-augmentation there is a finite maximum rate of capital-augmentation. Rates of augmentation are here considered as geometrical rates of increase of E and F . Thus the G_E , G_F possibility frontier can be described; as in figure one it is assumed to be continuous, smooth, and convex to the origin. Notice that the rates of augmentation can be negative. This evidently reflects one or both of two things. 1) Technological progress is to some extent, at least, embodied in the capital goods in use, and when they are junked, the processes they embody are no longer available. This embodiment is not explicitly considered in most

³Since if so, then $Y/K = f(E, \frac{FN}{K})$, thanks to the constancy of returns to scale, and $\frac{FN}{K}$ also exactly determines the marginal product of capital.

⁴E. Dandrakis and E. Phelps, "A Model of Induced Invention, Growth, and Distribution," Economic Journal, LXXVI, 4(Dec. 1966), pp. 823-39; P. Samuelson, "A Theory of Induced Innovation along Kennedy-Weiszäcker Lines," Review of Economics and Statistics, XLVII, 4(Nov. 1965), pp. 343-56; W. Fellner, "Technological Progress and Recent Growth Theories," American Economic Review, LVII, 5 (Dec. 1967), pp. 1073-98.

⁵C. Kennedy, "Induced Bias in Innovation and the Theory of Distribution," Economic Journal, LXXIV, 3(Sept. 1964), pp. 541-47.

growth models using the frontier, however. 2) Skills once used can be forgotten rather rapidly if they go out of use.

Now, it happens that profits are maximized in the economy as a whole when the absolute value of the slope of the frontier (ff in figure one) is equal to the notional distribution of income, i.e. MP_K^K/MP_N^N . The term the notional is used because it does not matter whether the factors are actually paid their marginal products. It assumes nothing about the actual factor payments, but rather assumes that the quantities of the factors available are strictly limited. From the point of view of the individual firm, this is not so. The individual firm maximizes its profits when the absolute value of the slope of its innovation-possibility frontier is equal to the ratio of its actual factor costs, rK/wN . The principle is that a given degree of capital-saving, for example, allows that proportional saving of capital and hence of capital-cost on each unit of capital used at the outset. Hence the "marginal product" of one percent of augmentation of the technical efficiency of capital is rK times one percent. However, Fellner argues⁶ that if, for example, general monopoly conditions lead capital to be over-valued, and hence for an excessively rapid augmentation of capital to occur, the rate of interest will drop (or will fall more rapidly than it would otherwise) and firms which are investing in durable capital goods, if farsighted, will choose techniques less capital-intensive than they would otherwise choose. It would appear that the only rate of augmentation of

⁶W. Fellner, "Two Propositions in the Theory of Induced Innovations," Economic Journal, LXXI, 2 (June 1961), pp. 305-8.

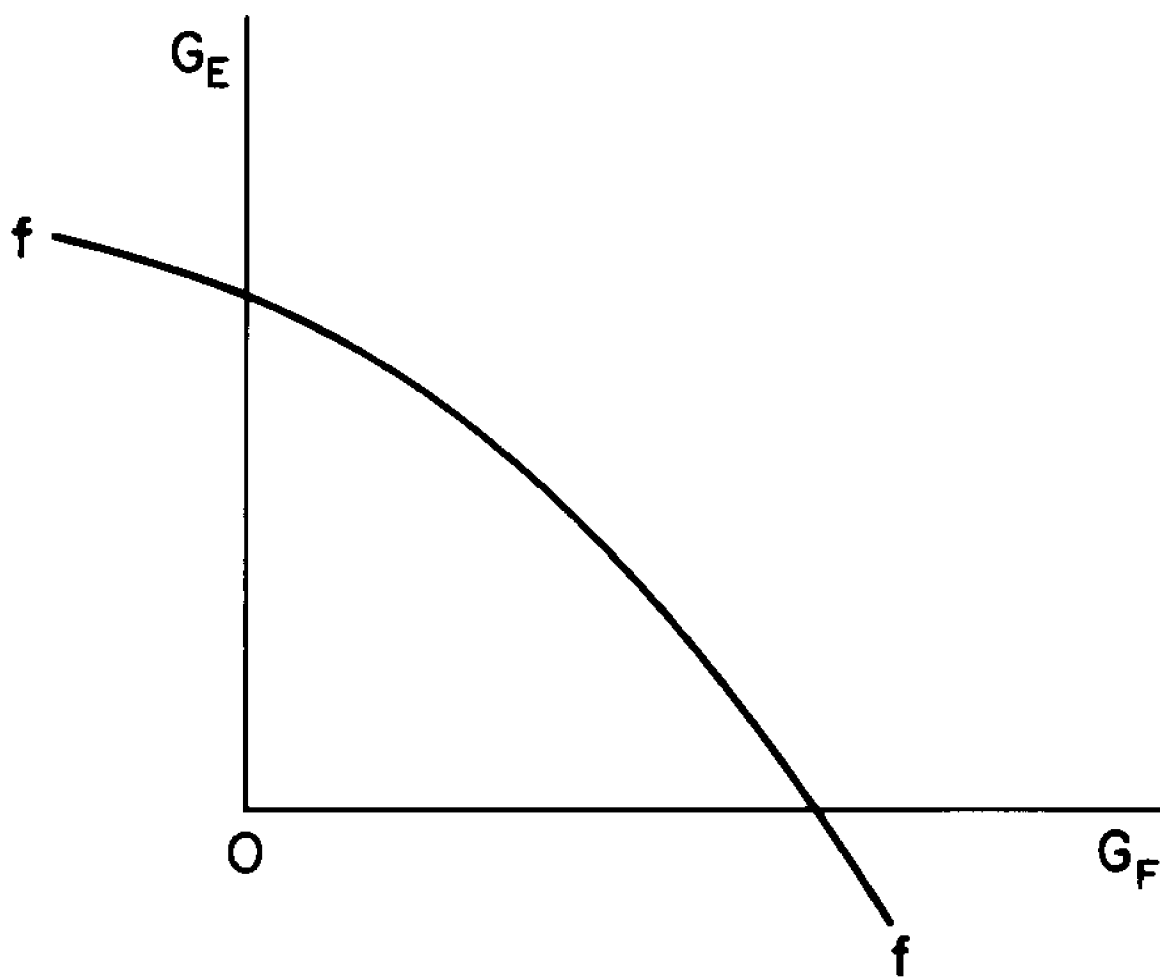


Figure 1

capital and labor consistent with the fulfillment of investors' expectations will be that consistent with the macroeconomic conditions of scarcity of capital and labor. The issue does not arise if the economy is competitive, however.

If net capital formation as a proportion of net national product is constant, and if there is some augmentation of capital, the capital stock will grow at the same rate as the net national product, which will be rather greater than the growth of FN , the labor force in efficiency terms. The difference depends in part on the rate of capital augmentation. When EK/FN is growing, if the elasticity of substitution is less than one, rK/wN (presuming competitive factor payments) is growing. Hence the absolute value of the slope of the frontier ff increases; that must mean (since the frontier was assumed convex toward the origin) that the rate of labor augmentation will be increased and the rate of capital augmentation decreased as the economy moves down the frontier.⁷ The converse is true if capital augmentation at the outset is negative. Thus the rate of capital-augmentation tends to zero.

It has been shown elsewhere⁸ that land can be brought into the model as a third factor of production. The rate of land-augmentation will tend to become equal to the sum of the rate of labor force growth and the rate of labor augmentation. Thus, the greater is the rate of labor force growth (i.e., the greater is the rate of

⁷ It is at this point that the downward convexity of the innovation-possibility frontier becomes crucial.

⁸ R. McCain, "Land in Fellner's Neoclassical Model of Economic Growth: Comment," American Economic Review, LX, 3 (June, 1970), pp. 495-499.

population growth) the greater is the rate of land-augmentation, and the less is the rate of labor augmentation therefore. In Figure Two, this is represented by a movement of the intersection of the 45° line with the partial innovation-possibility frontier pp upward, with an increase of the rate of population growth. The frontier pp is the innovation-possibility frontier which corresponds with a zero rate of capital-augmentation, and which will thus be effective in the long run. If the relationship between income per capita and the rate of population growth is as g_2 in Figure Two, then even with maximal population growth, labor-augmentation (and hence growth of income per capita) can go on at rate G_0 . If the relation is like g_1 , however, the rate of population growth stabilizes at the rate of land-augmentation consistent with zero labor-augmentation and hence zero growth of per capita income. Per capita income is then constant at y_0 . Since underdeveloped countries are countries with high potential population growth, and low potential for technological progress as well no doubt, it seems likely that this case if any would apply to them. However, it might be that the assumption that the country is actually on its innovation-possibility frontier is itself unjustified. When unemployment of other resources is common, it would seem plausible that resources potentially available for factor-augmenting technological progress would be unemployed as well.

Atkinson and Stiglitz have argued⁹ that in a process-choice model, technological progress is likely to enhance the productivity of

⁹A. Atkinson and J. Stiglitz, "A New View of Technological Change," Economic Journal, LXXIX, 3 (Sept. 1969), pp. 573-78.

LAND AUGMENTATION

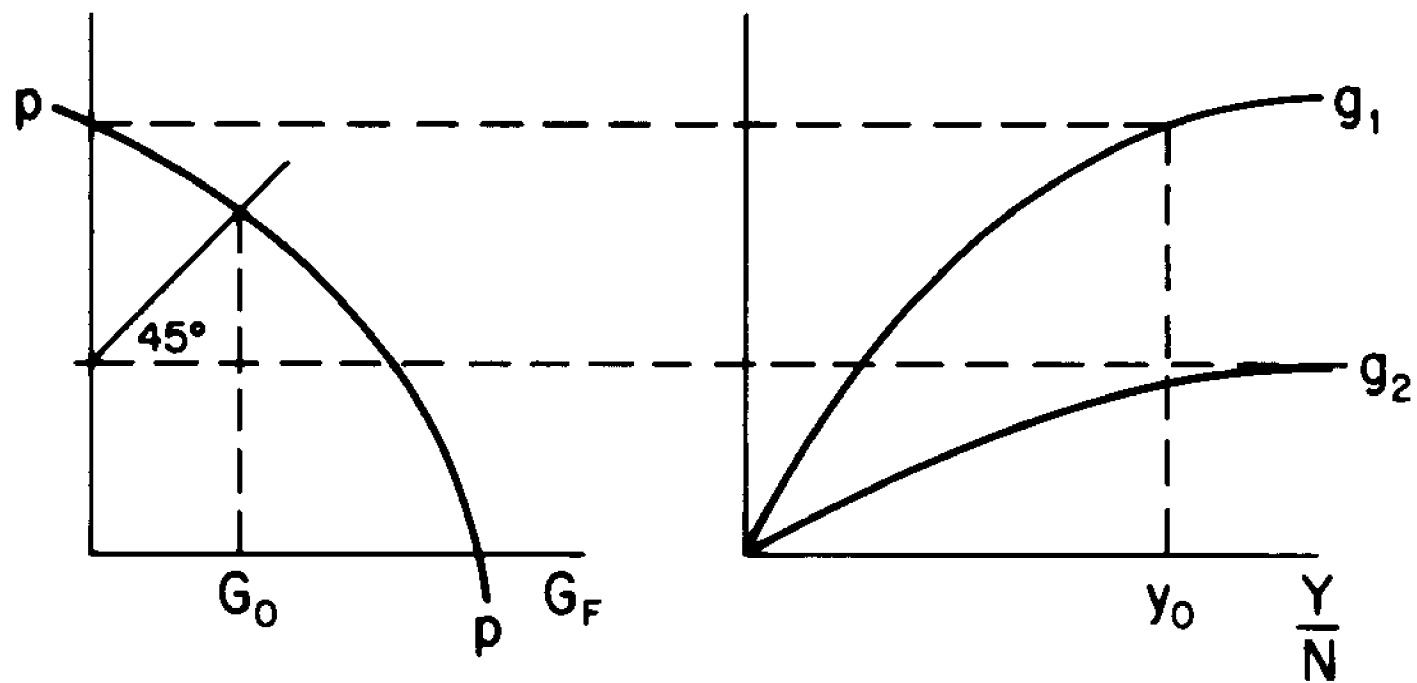


Figure 2

factors only when they are used in the single process for which they were intended, which will be that in use in the time and country in which the innovation takes place. This would mean that the technology of the developed countries, in particular, would be adapted to their factor proportions and hence would be unadapted to the factor proportions prevailing in underdeveloped countries.

Atkinson and Stiglitz' conclusion is based on a process choice model of production. The process-choice model assumes that there is only one output and that each process by which output may be produced requires fixed quantities of labor per unit of output. However, it assumes that there are several processes requiring different proportions of capital to labor among which the economy can choose. Thus, the process-choice model is a heroically aggregated¹⁰ version of a Leontieff input-output model with multiple processes of production. Atkinson and Stiglitz argue 1) that there is no incentive to search out, develop or undertake innovations with regard to processes other than those which are in use, so that only those processes, which require a particular relative abundance of factors, will be improved, and 2) that "learning by doing" will occur only in those processes. This seems to support the concept of trade-dependent growth, broadly, in the following way: it seems to imply that if techniques used in other countries are adopted at all, they must be adopted whole. This is an indivisibility of a sort, and would explain the extreme dependence of countries which have in fact introduced only a part of

¹⁰This phrase is due to William Stober, though he used it in a broader context.

a process on imported capital goods and semifinished materials.

The concept of technological progress due to "learning by doing" is due primarily to Arrow,¹¹ and Robinson¹² and Levhari¹³ have investigated it.¹⁴

Arrow's hypothesis is that a major part of technological improvement is the result of a process of learning by doing in the act of production itself. Arrow postulates that each new investment initiates a process of learning by doing which eventually works itself out with a fairly predictable increase in efficiency of labor. Hence the rate of technological progress is proportional to gross investment. So far only one conclusion of interest for economic development follows. It is that in any economy which grows at a steady rate, the private rate of return to investment (which excludes the technical progress, which is assumed to be entirely external to the firm) is less than the social rate of return.

Hirschman has speculated¹⁵ that a learning model would be an

¹¹K. Arrow, "Economic Implications of Learning by Doing," Review of Economic Studies, XXIX, 2 (June 1962), pp. 155-73.

¹²J. Robinson, "Symposium on Production Functions and Economic Growth: Comment," Review of Economic Studies, XXIX 2 (June 1962), pp. 258-66; "Learning by Doing: A Further Note," Review of Economic Studies, XXX (Oct. 1963), pp. 167-68.

¹³D. Levhari, "Further Implications of Learning by Doing," Review of Economic Studies, XXXIII, 1 (Jan. 1966), pp. 31-38; "Extensions of Arrow's 'Learning by Doing,'" Review of Economic Studies, XXXIII, 2 (Apr. 1966), pp. 117-32.

¹⁴Note also P. Belli's empirical inquiry in "Farmer's Response to Price in Underdeveloped Areas: The Nicaraguan Case," American Economic Review, LX, 2 (May 1970), pp. 385-392. This summary of Belli's doctoral dissertation reports his estimate of the importance and rate of learning among new Nicaraguan cotton farmers. He finds that learning was significant, but slow (p. 390).

¹⁵Op. cit., p. 47.

appropriate description of the process of economic growth. Arrow's learning model does not embody the kinds of effects Hirschman had in mind, but it does appeal to the institution that the "economic implications of learning by doing" are of particular importance for economic development. Unfortunately, the implications of Arrow's model for economic development have not been worked out. It does appear plausible that, levels of gross investment being low, the rate of technological improvement would be small.

It would appear from these theories of technological change that foreign technological improvement would be of benefit to the underdeveloped country only subject to the kinds of constraints the two-gap theory assumes; that there would be relatively less domestic technological improvement; and that what domestic improvement does occur may be primarily concentrated in the augmentation of the quantity of land, because of the high rates of population growth. Other approaches to technological change might produce other results. In any case, it is not clear that technological improvement controverts the assumptions of the model of the last chapter.

CHAPTER 5

ECONOMIC INTEGRATION IN COUNTRIES UNDER A TRADE CONSTRAINT

Schemes of economic integration among underdeveloped countries have been a subject of a great deal of speculation and controversy¹ during the past two decades. Several have been tried by groups of underdeveloped countries, and attempts recur.² However, such blocs have faced considerable organizational problems. The purpose of this chapter is to argue 1) that countries subject to trade constraints may in some cases benefit from integration schemes, 2) that because there is a tendency for the developed-underdeveloped relationship to reproduce itself among underdeveloped countries which trade freely among themselves, such schemes may be expected to break down if there are no positive steps taken to assure against internal trade-dependency, and 3) that the most simple and politically expedient positive steps which can be taken are precisely the ones which are most foreign to

¹A review of the controversy would seem to be beyond the scope of this paper. R. A. Flammang surveys the issues in Chapter 7, "Regional Integration," in W. Krause, Ed., The Economy of Latin America, (Iowa City, Iowa: Bureau of Business and Economic Research, College of Business Administration, The University of Iowa, 1966). M. Wionczek, Economic Cooperation in Latin America, Asia, and Africa, offers a representative bibliography, p. 555. (Cambridge, Mass.: The MIT Press, 1969).

²Wionczek, op. cit., pp. 7-12.

the conventional theory of trade integration, that is, protected national monopolies in particular sectors. The three sections of this chapter will take up those three topics in order.

I. The Benefits of Trade Integration

Countries which suffer from chronic trade deficits at or near full employment can potentially benefit from trade integration in three ways: 1) through improved allocation of resources within the group which integrates, 2) through improved bargaining power vis-a-vis the rest of the world,³ 3) through area import substitution, which will be discussed below. The first two sources of gain are familiar as they are available to other countries as well, although the significance of improved bargaining power may be greater in countries which are trade-constrained. This is so because increased imports may mean a closer approach to full utilization of resources in such countries. The third item, however, deserves some comment. Suppose that country A has been obtaining a necessary import good from some developed, hard-currency country. However, following the initiation of a new trade-integration scheme, country A finds it possible to obtain the good from country B, while country A's capacity to import from hard-currency countries is unchanged. The proportion of its total consumption and investment which must consist of goods imported from hard currency countries is, however, reduced, since one of the goods which has formerly been so obtained is now obtained from country B. It follows that country A will now be able to produce

³R. Allen, "Integration in Less Developed Areas," Kyklos, XIV, Fasc. 3 (1961), pp. 315-34.

more, with higher employment and capacity utilization, consistently with its given capacity to import from hard-currency countries. The effect is the same as if country A had initiated domestic production of the commodity, substituting its domestic production for imports. In fact, it has substituted bloc or area production for its imports, and thus the term area import substitution was chosen.

Whenever a country can import from a neighbor outside the hard-currency group a good which it has previously imported from a hard-currency country, without reducing its exports to the hard-currency countries, it in effect gains the amount of hard currency which it saves. It can then expand its purchases of other goods produced in hard-currency countries, and insofar as they are complementary to unemployed or underemployed domestic resources, it can expand its employment of them and thus can expand its output. Precisely the same effect can be obtained, however, if the country initiates production of the good on its own account. Nevertheless, importation from another soft-currency country will be advantageous in case 1) the importing country is at a comparative disadvantage in its production, or 2) the importing country cannot for some reason undertake the production of the good. The latter is a troublesome case. If Linder's explanation⁴ of the reasons for the failure of underdeveloped countries to produce some kinds of goods is recalled, the difficulty with the second case will be seen. Linder argues that certain goods cannot be produced (at least not at competitive world

⁴Trade and Trade Policy for Development, (New York: Praeger, 1967), p. 38.

prices) and pay subsistence factor returns to the factors used in producing them, due to the low level of absolute productivity of the underdeveloped countries. It is only as productivity advances that it becomes possible for the underdeveloped country to begin production of a particular good. Now, suppose that country A is for this reason unable to produce a certain good, which, however, country B can produce. It would appear more plausible that country B is absolutely more productive than country A. In fact, this may not be so: the sequence of goods may differ in the two countries due to different resource endowments, so that even though their absolute productivity is about the same, one is able to undertake the production of a particular good, production of which is infeasible for the other. However, this is clearly a special case of comparative advantage and hence properly a matter of resource allocation. Thus it is assumed that country B will be more productive in absolute terms than is country A. Two things follow. One is that there will be no commodity which for similar reasons can be produced in country A but not in country B. The second which follows from the first, is that country A will in effect be forced to pay for its imports with "traditional" exports. These two points indicate that the relationship of country A to country B corresponds closely to that of an underdeveloped country to a developed country. To the extent that this is so, it seems at least possible that trade integration would be of no benefit to the less developed country A and might even harm it. Country A would be paying higher than world-market prices for goods imported from country B yet facing competition which domestic producers could not meet. Of course, if country A is able to

conserve hard currency by selling in country B goods for which there is no export market in hard-currency countries, country A may nevertheless be benefitted.⁵ The same is true if the market for "traditional" exports can be expanded with some resulting increase in the demand for them. However, it seems likely that eventually the developed-underdeveloped relationship will be reproduced between country A and country B, as it might be between two regions of a single country.

The case of trade according to comparative advantage among underdeveloped countries contains two subcases: constant or decreasing returns to scale, and increasing returns to scale. The second case is the one which seems important for trade integration. It is a case of trade according to comparative advantage, in the short run at least, because the country which is an established producer of the good will have a comparative advantage, at the margin, over a newcomer unless the newcomer has extremely favorable conditions of production. However, the subcase of increasing returns to scale overlaps the second case, also, since one reason why a country might not be able to initiate production in a particular sector is that it has not a large enough market to make production feasible on an efficient scale. Indeed, it may be that both countries A and B are unable to initiate production in a particular sector on the basis of the domestic markets, but that one country or the other, or, indeed, either country can do so if it is assured the market of both

⁵See J. Vanek, "Payments Unions among Less Developed Countries and their Economic Integration," Journal of Common Market Studies, V, 2 (Dec. 1966), pp. 187-91.

countries. In that case the potential gains from trade integration are clear: both countries can potentially save the hard currencies they may be spending on the import of the output of this sector, if they can substitute production from within one of the two countries for imports from hard currency countries.

A graphical presentation may make the contrast between the case of constant and increasing returns to scale clearer. Assume that at the outset, countries A and B produce only "corn." In figures 1 and 2, AC represents the unit cost of "steel,"⁶ denominated in units of corn foregone, assuming that subsistence rewards are paid to all factors (i.e., normal profits, subsistence wages, etc.). D_A represents the demand of country A for the output of "steel"; D_B that of country B, and D_{A+B} that of the two countries taken together. Clearly, in figures 1, in which "steel" is supposed to be subject to constant returns to scale, trade integration cannot make production feasible within the two countries; while in figure two, which assumes that the production of "steel" is subject to increasing returns to scale within the relevant range, the merging of the markets of the two countries makes production of "steel" feasible for a considerable range of

⁶Of course, it is not being argued here that steel ought to be priced at average cost. In section three of this chapter, it will be argued that antidumping clauses may be counterproductive where integrating countries are all assured some participation in the gains of large scale. In this case, it has been assumed that both countries pay the same price. However, if price discrimination were practiced, the industry might be able to cover costs even in some cases in which the demand curve D_{A+B} is nowhere above the AC curve.

I owe this point to John Guthrie, Washington State University, although it was made in the context of public-utility pricing, not international dumping.

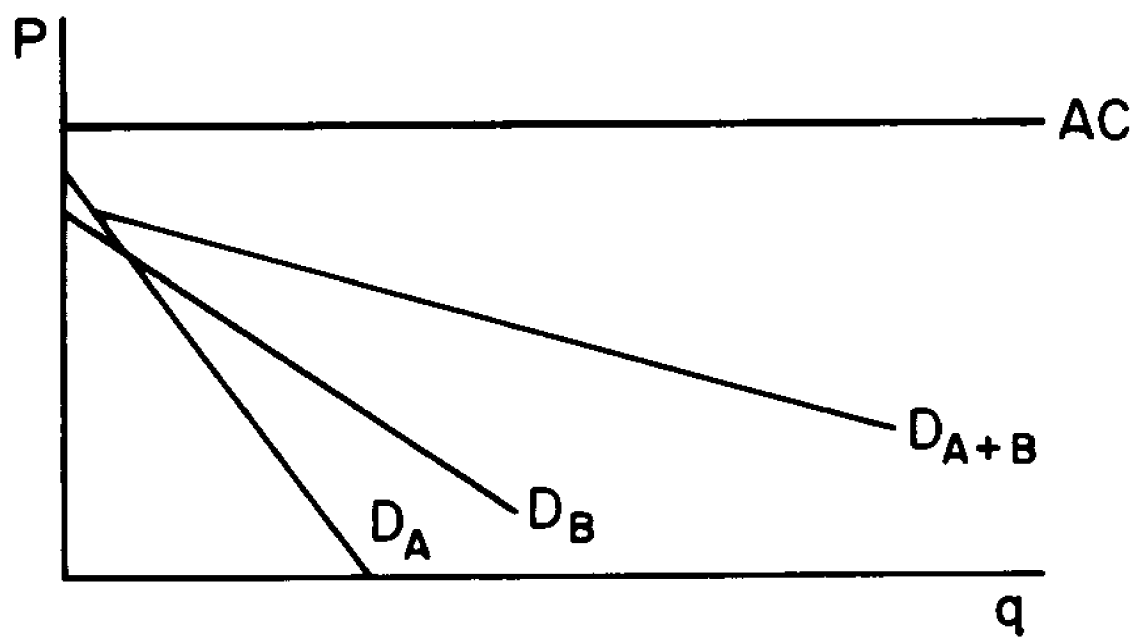


Figure 1

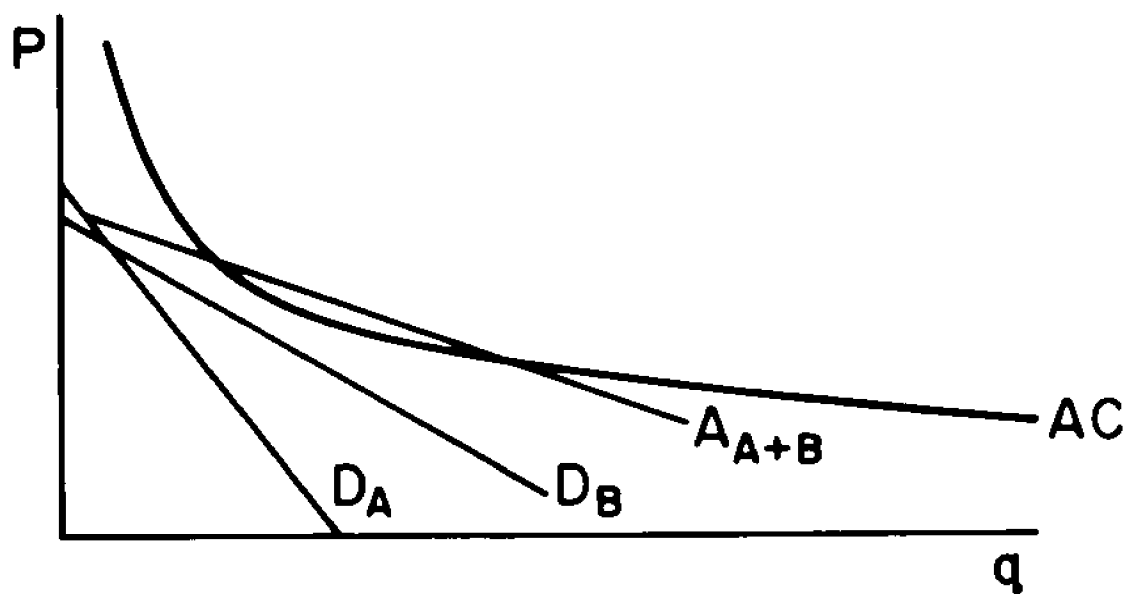


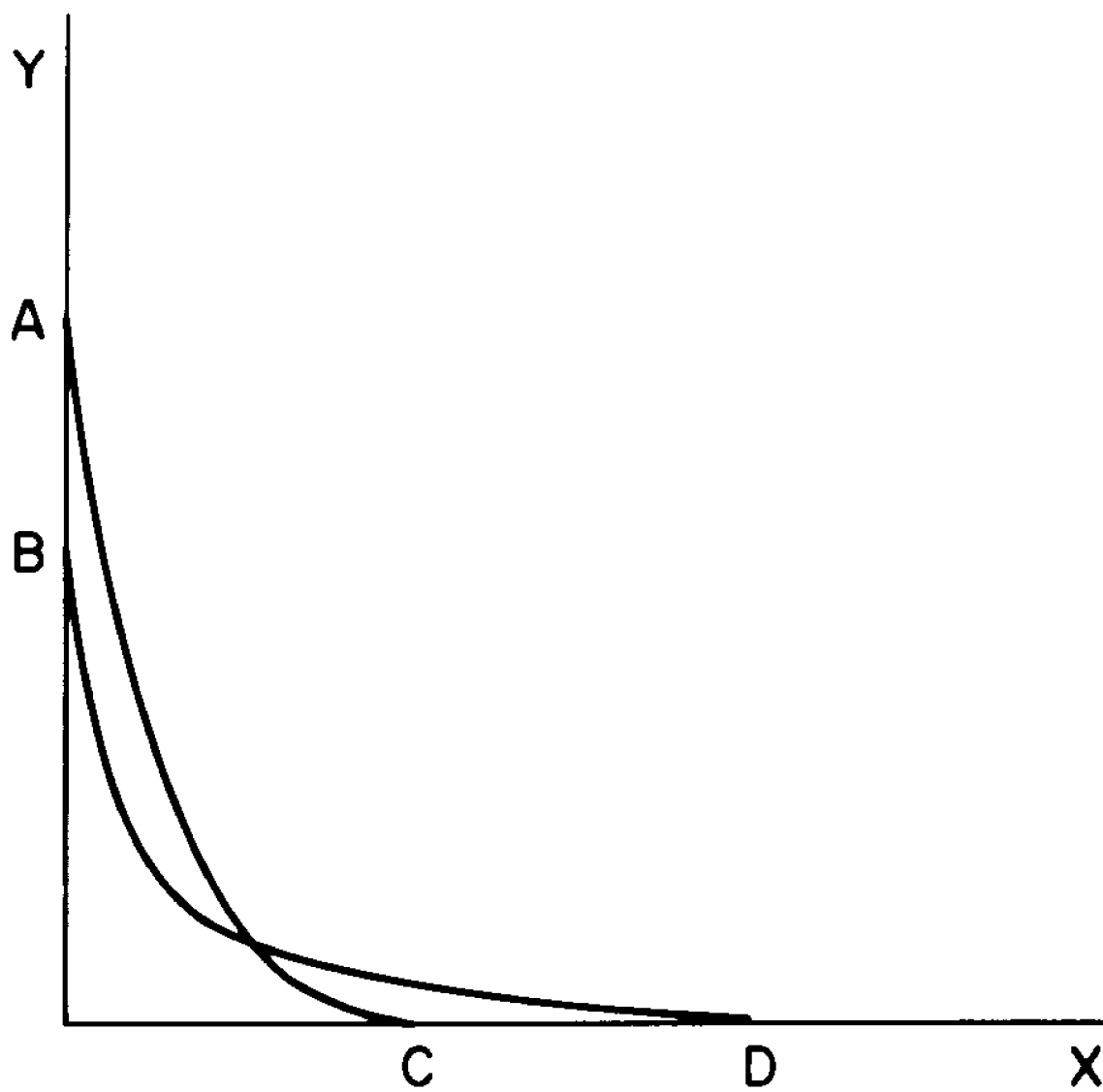
Figure 2

output.⁷ In figure two, it would appear that an even larger output

⁷Recognition that specialization in production results in even greater allocative gains under increasing returns to scale than under constant returns is, I believe, due to Frank Knight. Frank Graham had argued that protection was merited when one industry displayed increasing returns to scale, in "Some Aspects of Protection Further Considered," Quarterly Journal of Economics, XXXVII, 2 (Feb. 1923), pp. 199-227, and "The Theory of International Values Further Considered," Quarterly Journal of Economics, XXXVIII, 1 (Nov. 1923), pp. 50-86. Knight replied in "Some Fallacies in the Interpretation of Social Cost," Quarterly Journal of Economics, XXXVIII, 4 (July 1924), pp. 582-606, reprinted in K. Arrow & T. Scitovsky, Eds., Readings in Welfare Economics, (Homewood, Ill.: Irwin, 1969), pp. 213-227, that with increasing returns to scale, one country would specialize completely in one of the two goods, and that the price would then be that prevailing in the other country, which would, in fact, be the most favorable price to the specialist. He did not go on to point out that the terms would then be even more favorable than under constant costs with complete specialization, because of the expansion of the scale of its industry. However, he brushed aside Graham's concern with elasticities of demand with the comment that they are irrelevant to the study of international trade, and failed to consider any possibility that specialization might take place in the "wrong" direction. Consider the figure on the following page. X and Y are two goods, one or both of which are produced under increasing returns to scale. AC is the production possibility frontier for country A while BD is the corresponding frontier for country B; the differences in the production possibility frontiers reflecting differences, let us say, in climate. A static allocative optimum would require that country A specialize in the production of Y or that country B specialize in the production of X. However, if due to some historical accident, country A should have a "head start" in the production of X, presuming X to be produced subject to increasing returns, country A might specialize in X, at point C. If that were so, depending upon consumption in country B, the X industry in country B might not be able to attain sufficient scale to compete with imports from country A, and hence country B would specialize, by default, in good Y, at point B. This is clearly an inferior solution; it is, however, a local optimum and hence quite probably stable, even though the global optimum is reverse specialization.

It is of interest in this context that B. Higgins has speculated (Economic Development rev. ed., New York: Norton, 1968) that the developed countries have a long-run relative advantage in agriculture, considering their climates and soils.

Even if problems of static efficiency can be excluded, of course, the possibility of a conflict of static and dynamic efficiency may remain.



Figure, Footnote 7

of "steel" would be produced still more efficiently. Hence, production of "steel" may not be efficient enough to be competitive on world markets. Notwithstanding, if countries A and B face a chronic shortage of foreign exchange,⁸ they may benefit from integration and protection of steel production within one of the two countries.

Before leaving this point it seems appropriate to comment on the concept of increasing returns to scale, or decreasing costs, which it implies. Decreasing costs may exist, for some range, whenever there is an indivisible investment of appreciable cost which increases the net product. It needs not literally be necessary for efficient production, but needs only be efficient for the appropriate range of output. The relationship between indivisibility and increasing returns is well known.⁹ In an ideal trade-constrained economy, imported input goods are a pure bottleneck of production. Domestic input goods are redundant relative to imported input goods. In that case, however, costs are to be calculated in terms of input imports foregone, or in other words of foreign exchange foregone. The use of a small quantity of additional domestically produced

⁸It is worth noting that such a "corn-and-steel" economy can suffer from a factor proportions problem along the lines of Chapter Four; that is not obvious prima facie. Clearly, "steel" must be regarded as the imported capital goods. "Corn" would be both an export good and, as "seed corn," perhaps, the domestic capital good. Now, domestic capital goods and export goods would, obviously, have identical production functions; otherwise this would be a special case of the economy of Chapter Four.

⁹See e.g., T. Scitovsky, "Two Concepts of External Economies," Journal of Political Economy, LXII, 2 (1954), pp. 143-51, reprinted in Readings in Welfare Economics, pp. 242-252. The particular reference is to p. 247 there.

capital goods, or of labor, does not require the country to forego any production, and is thus at zero cost. Now, suppose that the construction of a plant requires a fairly large quantity of imported capital goods, and its operation thereafter requires a certain number of units of imported inputs for every unit of output. The plant is, in effect, subject to constant marginal "cost," which, with a positive fixed cost, means that the average cost is everywhere declining. (See figure three.) This might not be true in a non-trade-constrained economy, in which domestic inputs would be used only at positive cost.

The system of valuation implied in this discussion has been used explicitly in a planning model for the State of Israel, by Michael Bruno.¹⁰

To recapitulate, integration and the substitution of goods produced in soft-currency neighbor countries for goods previously imported from hard-currency countries can be beneficial insofar as it permits an actual saving of hard currencies, if hard currencies are chronically in short supply. However, substitution of domestic production for such imports is an alternative against which such importation from other underdeveloped countries must be considered. Importation is justified when the importing country is at a relative disadvantage in the production of the good, or where there are economies of scale in the relevant range, so that a single plant

¹⁰"The Optimal Selection of Export-Promoting and Import-Substituting Projects," in Planning the External Sector: Techniques, Problems, and Policies, Report on the First Inter-Regional Seminar on Development Planning (New York: United Nations, 1967) pp. 88-135.

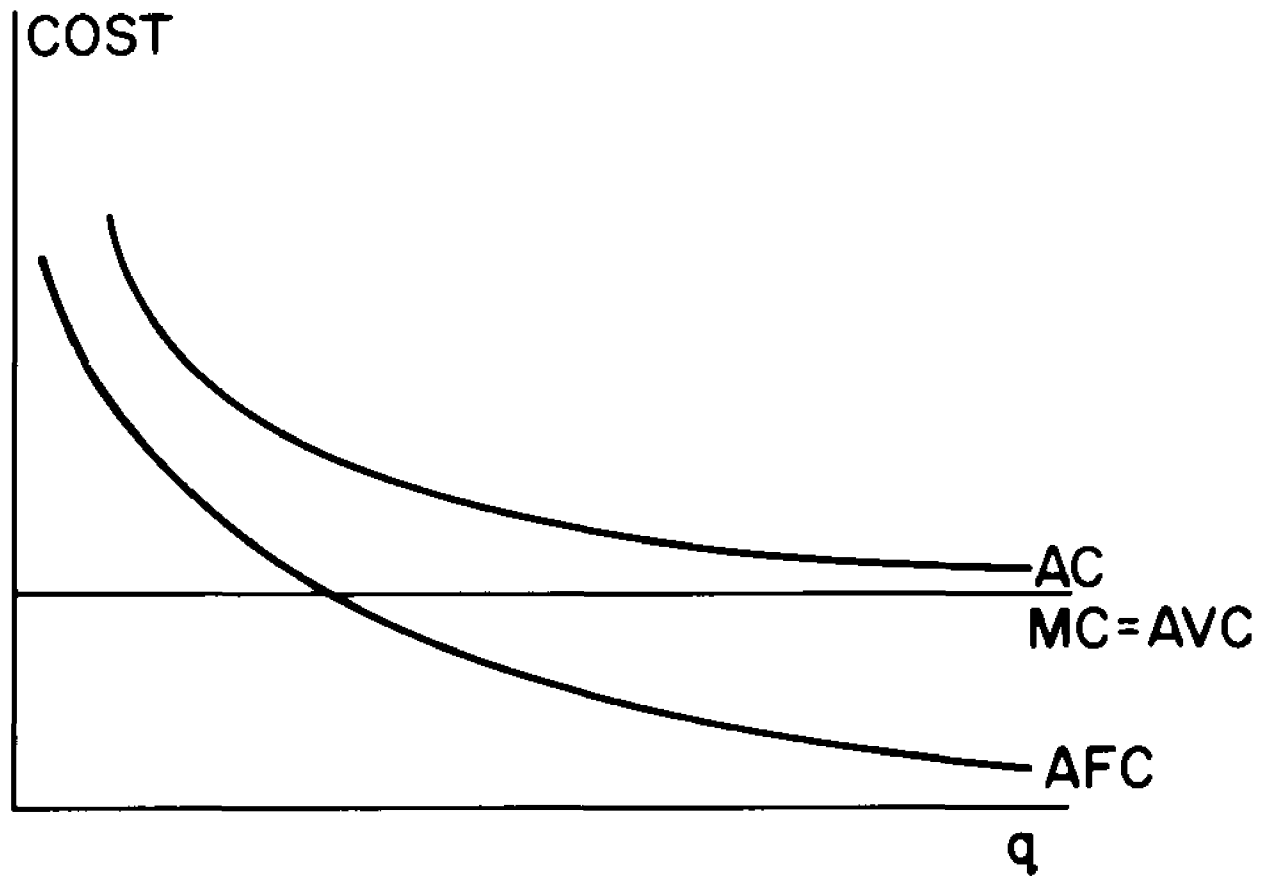


Figure 3

producing for a number of countries may be feasible while a number of plants would not. (The two cases are not distinct.) Even when importation is justified as against domestic production, importation from a neighboring country or a partner in an integration schema is not necessarily more advantageous than importation from a hard currency country. If the cost is higher in money terms (and if the quality is inferior), as is likely to be the case when the good is imported from another underdeveloped country, the advantages of saved hard currency must be weighed against the disadvantages incurred. It is beyond the scope of this section to consider this question. However, the possibility clearly exists that economic integration may make feasible import substitution which would otherwise be infeasible, when there are economies of scale in the relevant range. This is also true in a competitive sector in which there are economies external to the firm but internal to the sector.

None of the benefits which integration implies for a trade-constrained economy is novel. However, both the improvement of bargaining power and the potentiality of realizing economies of scale take on a different and increased significance in such economies. Insofar as bargaining power makes it possible to increase the capacity to import ceteris paribus, it permits expanded employment or capacity use, and hence increases the real income by some multiple of the simple increase in imports itself. The realization of economies of scale may make possible some kinds of import substitution which would not be possible otherwise, and thus increase the output and employment of the trade-constrained country with a given capacity

to import, similarly increasing real income by more than the amount of the import-substituting production alone. Thus it would seem that the potential gain from integration among trade-constrained countries may be great. Unfortunately, the obstacles may also be great.

II. Obstacles to Trade Integration

The greatest obstacle to trade integration among developing countries seems to be a tendency for the primary benefits of integration to go to the most developed member of the bloc among which integration is attempted. This section will consider how this might come about among countries which are trade-constrained, and the next section will review some of the attempts at integration which have been proposed or implemented in the light of their likely results in the case of such a disproportion of the gains.

In Chapter Four, some forces were considered which can lead to a tendency to economic disintegration within a single underdeveloped country as well as between developed and underdeveloped countries. Certainly the same forces can account for a tendency to disintegration among underdeveloped countries. It was pointed out in the preceding section of this chapter that the more advanced country in a trade community might have the capacity to produce some kinds of goods that the less developed countries could not produce. However, the converse would not be so. In that case, there might be some goods which the less developed countries within the union suffer from a chronic shortage of, at or near full employment, while the more developed country or countries have them in

ample, or even superfluous, supply. In that event, it would appear that the less developed countries in the trade community would develop a chronic balance of payments deficit with respect to the more developed partner or partners, just as they would toward the developed countries. If that should happen, clearly it would represent an obstacle to the functioning of the community in the general interest, to say the least.

Suppose that countries A and B are members of a trade community and country A develops a deficit in its trade with country B. Just what the results will be depend upon the payments arrangements between the two countries. A very likely case would appear to be one in which currencies are convertible within the community and balances are settled by transferring reserves of hard currencies. In that case, country A would have to exchange hard currency for country B's short-term balances of country A's currency. In effect, country A would be purchasing its imports from country B with hard currency. Country B would benefit exactly as if it had succeeded in increasing its exports to hard-currency countries, by an equal amount, quite aside from any benefits it might derive from the increased scale of its activities in the industries of export to country A. With economies of scale, its gains would be even greater. With an improved capacity to import, country B would be able to invest more and make a more nearly full use of its existing capacity, insofar as investment and capacity use had been previously constrained by the capacity to obtain necessary imports (i.e., insofar as country B had previously been trade-constrained). With greater investment, in particular greater investment of chronically scarce imported capital

goods, country B would grow more rapidly, would increase its productivity more rapidly, and would hence increase its lead over country A, ceteris paribus.

However, ceteris are unlikely to be paribus. If country B is intrinsically less productive than the developed countries, then its exports to country A are likely to be above world market prices. In that case, country A will be harmed, relative to its position without the community, since it will be unable, with its given earnings of hard currencies, to invest, produce, and grow even at its former rate.

A less likely case is that the currencies may be inconvertible. In that case, country B would be exchanging its outputs for balances of the currency of country A. While this output might be produced at little real cost to country B, the cost is hardly likely to be zero. Thus, it would appear that in this case country A would be benefited in two ways. First, it would save some hard currency which it must otherwise use to purchase the items bought from B. Second, it would be getting the latter at no cost, or at very little cost. If country B fails to use the balances it is accumulating, country A has the goods free; while if country B uses them in a catch-as-catch-can manner to get whatever can be marketed in country B at any price, then it is in effect accepting an involuntary reduction in the price of its exports to country A. Country B is hurt to the extent that the imported raw and semifinished materials embodied in its exports to country A exceed those embodied in its imports from A, at least.

A third possibility exists, although it seems even less likely. The currency of country A might be flexible in its exchange rate

relative to that of country B, or might be devalued relative to that of country B. It is not necessarily true that this would alleviate the shortage of the currency of country B, insofar as this arises from a chronic shortage of goods imported from country B in country A. Even if it should, it would mean either that the currency of country A would be devalued relative to the rest of the world, or that that of country B would be appreciated relative to the rest of the world. While it is not clear without further exploration what the results of this change would be, it seems that one country or the other would find it an unattractive one, since the existing exchange rates were presumably chosen somewhat with a view to their effect on relations between the country and the "rest of the world;" and the developed part of it in particular.

Of course, it is possible that some sort of bargain can be struck between country A and country B on the exact terms for the settlement of the claims within the community. However, it is the discovery and implementation of such a scheme that would seem to be the great political obstacle to cooperation in trade among under-developed countries. The second and third cases outlined above seem unsatisfactory in that it seems unlikely that the exporters in country B will be willing to exchange their product for a currency which is of uncertain value. Hence, either the currencies will be convertible or there will be no actual trade integration. If they are convertible, and if one of the countries has a chronic balance-of-trade deficit toward one or more of the others, the entire benefit of hard currency saved will go to the surplus country, most likely at some cost to the deficit country.

One other obstacle needs to be mentioned, which may be even more important from a political viewpoint. It is this: customs receipts are a major source of revenue to many underdeveloped countries. Hence, when a country substitutes tariff-free or reduced-tariff area products for full-tariff external products, it loses the revenues involved. It may be possible to recoup the loss by imposition of a tax of some other kind (in principle it certainly is), but given the relative inefficiency of tax authorities in many underdeveloped countries, this may not be a very workable alternative. Where the goods are only moderately processed by the country exporting them, the customs revenues on the intermediate or semifinished goods now accrue to the exporting country, increasing its revenues. Thus, again, the countries which export manufactures to the area may benefit at the expense of those which do not, even where the growth of the latter is not affected. Even where trade is balanced between the two countries, the exports of one country may be of a low-tariff category while its imports are of a high-tariff category. Again, it would lose revenues and the other country would lose less. Thus, in many cases, redistribution of customs revenues may be needed to assure a reasonably equitable distribution of the gains of area trade; or even to assure that trade integration will be of mutual benefit.

III. Some Institutional Responses

There have been at least eight regional schemes of economic cooperation among underdeveloped countries in recent years.¹¹

¹¹Wionczek, Op. cit., p. 12.

Certainly one of the most ambitious projects has been the Latin American Free Trade Association (LAFTA). It is a scheme fundamentally based on the concept of trade liberalization, but a payments union, common external tariff, and special treatment for the less developed members and fostering of complementarity among the participants were originally proposed as long-term objectives.¹² However, its progress during the sixties was limited. There was some evidence of the emergence of systematic deficits in intraregional trade, not only for the poorest countries (Paraguay and Ecuador), but for the "middle group," Chile, Columbia, Peru, and Uruguay. This evidence, it should be stressed, is far from conclusive.¹³ Several articles of the Montevideo Treaty authorize the imposition of protective measures on intraregional trade by a less-developed member, in the event of a trade deficit, as a temporary measure.¹⁴ Note that such protective measures amount, in effect, to the partial and temporary nullification of the treaty. If the hypotheses of this paper are correct, they will do nothing to correct the fundamental problem; hence these and similar escape clauses are in effect self-destruct mechanisms insofar as the less-developed members' accession to the community are concerned. The only direct provision of the LAFTA treaty for positive measures to alleviate the deficits of less-developed members is the authorization of subregional arrangements

¹² Ibid., p. 34.

¹³ Ibid., p. 37.

¹⁴ Ibid., pp. 47, 51.

and bilateral arrangements.¹⁵ A subregional arrangement among Colombia, Chile, Ecuador, Peru, and Venezuela was adopted in 1967.¹⁶ Such a subregional arrangement might accelerate the development of its participants relative to the other members, in the same way as the formation of a trade bloc could accelerate the development of its members vis-a-vis the developed countries. With respect to its own least-developed member, Ecuador, the subregional group has arranged for some protection of Ecuador's domestic market, but also, perhaps more importantly, have agreed to open their own markets to some of Ecuador's production on a basis of free trade, not to be extended to the other countries.¹⁷

There is a framework for a LAFTA-related payments union. Currency convertibility is not guaranteed.¹⁸ The Inter-American Development Bank has some power to assist in the implementation of LAFTA's aims, and has from the first attempted to do so. Among its programs in support of trade integration are a preinvestment fund for feasibility studies with regard to industries significant from the point of view of integration, a research and training institute, and a special program for financing trade in capital goods within Latin America.¹⁹ The Interamerican Development Bank also acts in support of the Central American Common Market. In addition, there

¹⁵ Ibid., p. 47.

¹⁶ Ibid., pp. 90-95.

¹⁷ Ibid., pp. 91-92.

¹⁸ Ibid., pp. 347-53.

¹⁹ Ibid., pp. 360-362; 398-408.

is a development bank parallel to the Andean group and supportive of its aims.²⁰

The Central American Common Market, prior to the recent Central American war, was widely considered the most successful of the trade cooperation schemes among underdeveloped countries. This can hardly be attributed to the intrinsic advantages enjoyed by the Central American countries, since, in fact, their circumstances were, to all appearances, unfavorable.

The Central American economies are characterized by heavy dependence on a few commodity exports. In 1961 coffee, bananas, and cotton accounted for 75 percent of the exports of the countries presently participating in the Central American Common Market....In the same year, 46 percent of the region's national income originated in agriculture, while manufacturing, the next largest contributor, represented only 16 percent. The area's underdevelopment, dependence on primary export-oriented activities, and the absence of complementarity among the five minuscule economies were for a long time considered extremely serious obstacles to regional economic cooperation.²¹

CACM is linked with a payments union which guarantees convertibility of the national currencies in dollars,²² and to a development bank, the Central American Bank for Economic Integration.²³ The bank is empowered to grant loans for a variety of purposes relevant to economic integration, including infrastructure projects intended to correct "disequilibrium" among the member countries. The bank may

²⁰Ibid., pp. 525-542.

²¹Ibid., p. 102.

²²Ibid., p. 326.

²³Ibid., p. 482.

also grant loans for industrial projects of regional significance,²⁴ and is neither directed nor forbidden, in its charter, from allocating them in such a way as to offset disequilibria among the member countries.

A critical element of the CACM scheme is the regime of Central American integration industries. Under this regime, at least one plant in each country, in an industry regarded as requiring access to the entire Central American market in order to operate with efficiency at minimum capacity, was to be designated a Central American integration industry. The products of Central American integration industries were to be granted free access to the market of all the participating countries at the outset, while the competing products of other Central American firms (if any) were to have annual ten percent tariff reductions, thus being subjected to free trade within the area at the end of ten years. Competing products from outside Central America were to be subjected to a common Central American tariff. Such integration industries are clearly an attempt to secure the advantages of scale, at least in part. However, integration industries might provide at least a buffer against the emergence of chronic trade disequilibria among the members, insofar as they assure at least minimum participation of all members (albeit undoubtedly at some cost in misallocation of resources).²⁵

In addition to the measures already mentioned which might act as buffers against the emergence of chronic disequilibria within

²⁴Ibid., p. 485.

²⁵Ibid., p. 121.

the community, some unilateral trade concessions were made to Honduras, in consideration of its relative backwardness.²⁶ It is worthy of note that "the rate of increase in trade flows to and from Costa Rica, Honduras, and Nicaragua exceeds that of the two more advanced countries." Nicaragua has, however, suffered a "traditional" deficit with the Common Market.²⁷

The East African Economic Community (Kenya, Uganda, and Tanzania) parallels CACM in some ways, although its members are more diverse in their levels of development and accordingly, the problems involved in integration have been greater. Like the CACM, however, the EAEC supplements trade liberalization with a variety of positive mechanisms related to the promotion of balance among the members, including a development bank.²⁸ Like the Central American countries, the countries of EAEC have a long history of attempts at cooperation; in the case of the East African Countries it extends well into the colonial period (indeed Kenya and Uganda have had some economic cooperation since the First World War). Both Tanzania and Uganda have suffered chronic deficits in their trade with Kenya under the Community and the arrangements which preceded it. Tanzania has evidently been in the worst position. Moreover, Tanzania and Uganda have felt that they also lost by the operation of the common services (until recently a common currency, customs and excise service,

²⁶Ibid., p. 104.

²⁷Ibid., p. 104.

²⁸Ibid., p. 409.

postal service and similar infrastructural services).²⁹ The arrangements now in force include the common customs and excise tax service, with the customs proceeds distributed equally among the three participants (this represents some redistribution in favor of Uganda and Tanzania), a development bank pledged to use a major portion of its funds in the promotion of industry in the less-developed members, and an industrial licensing system which is supposed to operate in favor of the less-developed members. In addition, it is permissible for a country which suffers a deficit in its total area trade in manufactured goods may impose a "transfer tax" on goods which originate in other member states, provided that goods of a similar description are being manufactured or are expected to be manufactured within three months of the time at which the tax is imposed. It cannot be imposed unless the industry in operation, or expected to begin operation, will exceed a specified minimum capacity or provide no less than 15% of the consumption of the good in the importing country. It is limited to 50% of the duty on similar goods imported from outside the market and to eight years duration. A variety of other limitations are applied to the transfer tax to assure that it can only be used to promote balance and self-sufficiency.³⁰ The treaty establishing the community specifies that payments will be made in a currency acceptable to the creditor country,³¹ but it

²⁹ Ibid., p. 163.

³⁰ Ibid., p. 178.

³¹ Ibid., p. 184.

appears that, at this time, the East African Shilling, the old common monetary unit, is still in use. The effect of a common currency would, of course, be the same as that of fully convertible currencies insofar as the allocation of the gains is concerned. The East African Development Bank differs from the Central American Bank for Economic Integration, and from other development banks, in being limited in its field of action to industrial promotion.³²

The Caribbean Free Trade Association also parallels CACM in somewhat more limited ways. Like CACM and the East African countries, the Caribbean countries have some history of attempts at cooperation; like the East African countries they have had the encouragement of Britain during the latter part of the colonial period. To some extent, CARIFTA must be inspired by the success of CACM nearby. However, despite the fact that the difficulties faced by the Caribbean countries would seem to be even more stringent, CARIFTA is a much less far-reaching arrangement. Little positive provision is made for providing the less-developed members with access to the area market: there are no integration industries or similar arrangements, and Jamaica's reluctance has delayed the implementation of a development bank.³³ There is no payments union and the treaty establishing the group makes no mention of payments clearing procedure.³⁴ In short, CARIFTA puts no instrument in the hands of a less-developed country

³²Ibid., p. 185.

³³Ibid., p. 129.

³⁴Ibid., pp. 130-58.

which might suffer a chronic imbalance with respect to the area other than the reimposition of restrictions, although the need for something like the integration industries regime of Central America is recognized.³⁵

Two trade liberalization schemes exist in the countries of Africa which were formerly French colonies. The Central African Economic and Customs Union, consisting of the Congo (Brazzaville), Gabon, the Central African Republic, Chad, and Cameroon, embodies a common market together with a number of schemes of industrial harmonization, and some common services. One of the harmonization schemes is a solidarity fund consisting of 20% of the proceeds from import taxes, to be redistributed in a mutually acceptable way. Another is the "taxe unique," an excise tax on area production which is paid to the consuming country, although it is collected at the point of production. The taxe unique presumes that the imported inputs and capital goods used in production will be exempted from tariffs. Thus it is designed primarily to encourage the production of consumers' goods within the area, while assuring the countries against the loss of customs revenues to another state as a result of production taking place there.³⁶ The taxe unique is not intended primarily to assure against divergences of the rate of development or balance of payments disequilibria within the area, but the Union offers the possibility that, as a transitional measure, different

³⁵ Ibid., p. 150.

³⁶ Ibid., pp. 234-36, 251.

rates of taxe unique on a single product category may be allowed, depending upon the place of production.³⁷ The West African Customs Union involves only trade liberalization, and that is limited: tariffs on area products are to be no more than half of those on goods from outside the area.³⁸ Neither treaty explicitly mentions clearance of payments among area countries, but both groups are franc-area countries. The West African arrangement embodies the usual escape clauses.³⁹

The so-called Arab Common Market is in fact a free trade area. That is, there is no common external tariff. It includes Iraq, Jordan, Kuwait, Syria, and the UAR. Settlement of balances is to be made by bilateral arrangements or in hard currency.⁴⁰ Several agencies have been proposed to create common services or enterprises, but the reluctance of one or another of the countries to participate fully has prevented their implementation.⁴¹ This arrangement provides for gradual abolition of tariffs on primary products to be complete in 1970, and on manufactured products by 1975 or earlier. Quantitative restrictions are subject to a similar provision, in that a certain percent of all products are supposed to be freed from such restrictions each year.⁴²

³⁷ Ibid., p. 252.

³⁸ Ibid., p. 280.

³⁹ Ibid., p. 280.

⁴⁰ Ibid., p. 285.

⁴¹ Ibid., p. 286.

⁴² Ibid., p. 298, 299.

The Regional Cooperation for Development scheme among Pakistan, Iran and Turkey proposes to develop industrial complementarity prior to trade liberalization. No liberalization scheme now exists, but a number of specialized agencies do, and development projects have been approved which would be jointly owned by the three countries and would serve the entire market.⁴³

The variety of arrangements which have been to some degree implemented can serve as ample evidence of the difficulty of reaching agreement on terms of trade liberalization among underdeveloped countries. Further evidence on that point, in the form of unimplemented proposals, could be supplied. It is less clear how this problem can be solved. It has already been argued that "escape clauses" are hardly a workable arrangement, if the hypothesis of Linder is admitted. It is true that a less-developed member of a trade bloc may impose restrictions on its imports, for balance-of-payments purposes, and still have access to the markets of the other members. However, if the less-developed member is to expand its area trade, it must expand its exports; and if it is less productive overall, it will find the expansion of its exports difficult because it faces the competition of the more productive, more highly developed members within their markets, even though not within its own. It has been given access to a market in which it has little to sell. Technical and financial assistance in diversifying its product, for which several of the arrangements provide, may help to establish new industries complementary to production in the other countries. In effect,

⁴³ Ibid., pp. 313-317.

they remove obstacles of another kind to the expansion of the area exports of the less-developed member. Still, however, it may be necessary to take more positive action to assure the expansion of trade among members of a trade bloc which have achieved different levels of development. The "integration industries" approach is one approach; other kinds of preferential arrangements could be undertaken also. There will be some cost in such preference, of course; but where there are economies of scale or minimum fixed investments, the benefits of expanded trade considered in the first section of this chapter may justify the costs. This is especially true, again, if the fixed investment requirements pertain to imported capital goods.⁴⁴

Most of the trade liberalization schemes considered make some attempt to assure convertibility of national currencies. This is clearly a key point, since currency restrictions can have the same effect in limiting trade that tariffs or quotas can have.⁴⁵ If there is a systematic tendency to trade imbalance among countries of rather different levels of development, currency convertibility will not be possible, over the long run, without positive measures to assure trade balance.

A point worth mentioning is that all of the trade liberalization agreements prohibit dumping. It is not clear that this is desirable. If there are economies of scale, dumping may be in the interests of

⁴⁴See section one, above.

⁴⁵See Vanek, op. cit.

all. It is true that it will tend to maintain the dependence of one country on another for the dumped product. However, if the dependence is reciprocal, and balance is maintained, there would seem to be no clear economic reason to object to such dependence. (Military reasons for such objection might exist.) Indeed, the concept of industrial complementarity, which evidently underlies several of these schemes (and would seem to be sound in the presence of economies of scale) requires just such dependence, the problem being to assure that it is reciprocal by assuring every member some positive participation. A system which maintains balance by assuring each country one or more modern-sector "integration industry" with the right to dump guaranteed, but no other market guarantee, might be almost an ideal arrangement. It would at least assure that the "integration industries" would be industries in which economies of scale did in fact exist.

IV. Summary

Linder argues⁴⁶ that trade may be a "superengine of growth," since it may under certain circumstances permit increased utilization of the resources of an underdeveloped country, rather than simply their more efficient allocation. This may be true in particular of trade among underdeveloped countries. In particular, when there are decreasing costs, the increased scale afforded by trade integration may permit a wider range of productive activities, with some resulting substitution of area products for the products of developed

⁴⁶Op. cit., p. 50.

countries. If imports from developed countries are, as the hypothesis of the two-gap theory would hold, chronically scarce, then instead of trade diversion the result will be an expansion of the economic activity of the underdeveloped countries among which the integration takes place. However, there are some obstacles to successful integration. In particular, there is no more reason to expect automatic equilibrium among underdeveloped countries of different attainments than there is to expect automatic equilibrium between an underdeveloped and a developed country. If there is a systematic tendency toward disequilibrium among the countries within an area, integration may be impossible without positive action to secure industrial complementarity. An examination of the integration institutions in force and attempted among underdeveloped countries reveals a variety of proposals to deal with this problem (and with the related problem of loss of customs revenue by the importing country). The evidence on the operation of such unions is extremely limited, but it is not inconsistent with the suggestion that those unions which have been most successful are those which have most strongly provided for industrial complementarity among the participating countries.

CHAPTER 6

INTRODUCTION TO THE EMPIRICAL STUDY

Time series national income data for eleven Latin American countries and Puerto Rico were studied in an attempt to determine, in each case, whether imports of goods and services may have effectively constrained investment during the period under study. The results are reported in Chapter Seven. The purpose of this chapter is to introduce the methods used and to present the common concepts underlying the interpretation of the results. The first section reviews the two-gap theory, drawing on the restatement of Chapter Three above, to point out the predictions of that theory as to the relationships to be expected among some national economic aggregates. It also points out the predictions drawn from a "standard" hypothesis based on the assumption that investment is unconstrained by imports. Section two discusses the problems of multicollinearity and autocorrelation of errors as they pertain to the studies reported in Chapter Seven. Section three considers the problem of errors in the data as they pertain to the studies that follow.

I

The two-gap hypothesis leads us to expect that in some countries, both current investment and current output will require a

necessary minimum component of imported goods and services. Imported goods include two subcategories: imported capital goods and imported consumers' goods.¹ For present purposes, imported consumers' goods includes those raw and semifinished goods imported for the manufacture of consumers' goods.² If imported capital goods and services are denoted by M_k , imported consumers' goods and services by M_c , and total imported goods and services by M , then

$$1. \quad M = M_k + M_c$$

by definition. However,

$$2. \quad M_k \geq aI, \quad a \leq 1,$$

where I represents gross domestic fixed capital formation, and a is a constant. Moreover,

$$3. \quad M_c \geq bY + g, \quad b \leq 1$$

where Y represents gross domestic product and b is a constant, and g is a constant representing required imports which are independent of the income level. Gross domestic product is the income measure chosen, rather than gross national product, or net national product, or national income, because the relationship stated in 3. is primarily

¹This follows S. Linder, Trade and Trade Policy for Development, (New York: Praeger, 1967). Imported capital goods include replacement imports as well as new capital goods.

²The two-gap theory rests mainly on the hypothesis that imported goods are in many cases complements to domestic goods in production. Of course, the minimum of imported finished consumption goods would be complements to domestic output in consumption, and that is a rather different thing. For present purposes, however, the difference is ignored.

not an aggregate demand relationship but a production relationship. That is, it states a requirement that a certain amount of imports be used per unit of production, regardless of the disposition of the product.³

Assuming that both constraints 2. and 3. are effective, they may be considered as equalities, and adding,

$$4. \quad M = aI + bY + g$$

However, M is not a dependent variable, but (from the point of view of two-gap theory) a given constraint in any year. Thus equation 4. is not the proper specification for a regression equation. Either I or Y must be treated as the dependent variable, and the other as an independent variable. Following Linder,⁴ it seems plausible that first priority of policy would be given to attaining full capacity output with existing plant, so that Y would be the independent variable. Thus,

$$5. \quad I = \frac{1}{a}M - \frac{b}{a}Y - \frac{g}{a}$$

Most of the attention of the statistical study will be given to relationships derived from equation 5. It is possible, however, that a "ruthless" development policy might give first priority to investment. It is also possible that despite government policy,

³This must be qualified as noted in footnote 2, p. 137 above. However, as Linder pointed out and as was pointed out above in Chapter 2, there may be reasons to consider "consumers goods" as input imports. Chapter 2 used the example of foodstuffs to raise minimal dietary standards; while Linder's example was Scotch whiskey for tourist bars.

⁴Op. cit., p. 12.

investment might assume the role of an independent variable through the operation of free market forces, perhaps connected with expectations. In that case, an equation of the form

$$6. \quad Y = \frac{1}{b}M - \frac{a}{b}I - \frac{g}{b}$$

would be appropriate. Regression equations of this form will also be given for comparative purposes.

Notice that, in either case, the coefficient relating Y and I is negative. This result is perverse in the sense that a "standard" hypothesis would imply a positive relationship between Y and I . First, a simple investment multiplier hypothesis would make income an increasing function of investment. Second, an accelerator hypothesis would make investment an increasing function of lagged income; but income is likely to be serially correlated, so that current income may be a good proxy for lagged income. In the two-gap theory, however, the result is natural enough: the quantity of imports being strictly limited, an increase in production means a deduction from the quantity of investment imports available and hence a decrease in capital formation, total imports being given. Thus, in a regression of capital formation against imports and gross domestic product, the Linder-Chenery hypothesis is rejected if the coefficient of imports is negative and if the coefficient of gross domestic product is positive.

Notice also that $\frac{1}{a} \geq 1$, as is $\frac{1}{b} \geq 1$. Thus, the Linder-Chenery hypothesis would be rejected also if the coefficient of imports in either equation is significantly less than one. (However, this result is of little use, since there is the possibility of a

downward bias in the estimates. This point will be considered in more detail in section III below, in the context of errors in the data.)

The "standard" hypothesis implies a positive relationship between investment and gross domestic product, and implies no systematic relationship of any kind between imports and investment. Thus the "standard" hypothesis is rejected if the coefficient of imports in a regression of the form of 5. is significantly positive, or negative, and if the coefficient of GDP is significantly negative.

Equation of the form of either 5. or 6. might be subject to a trend. Indeed, in a country subject to an effective imports constraint, with import-substituting investment, some trend is to be expected. There is no a priori reason to suppose that the trend is linear. However, the Linder-Chenery hypothesis specifies a linear relationship, so the other elements of the model will also be specified as linear. Accordingly, the first models tested will be of the form

7. $I = A + B_1t + B_2M + B_3GDP$ (Model 1)
8. $I = A + B_2M + B_3GDP$ (Model 2)
9. $I = A + B_2M$ (Model 3)
10. $I = A + B_3GDP$ (Model 4).

Models of each form were estimated for each of the countries in the study, but Models 2-4 will be reported in Chapter Seven only if one or more of the estimates of B_1 , B_2 and B_3 in Model 1 is not significantly different from zero. Also estimated were models of the form⁵

⁵As well, Cobb-Douglas specifications were tried with little useful result. Lagged and first-differenced regression equations were also tried, generally with poorer results than those reported.

$$11. \text{ GDP} = A + B_1 t + B_2 M + B_3 I \quad (\text{Model 5})$$

$$12. \text{ GDP} = A + B_2 M + B_3 I \quad (\text{Model 6})$$

The estimates for Model 5 will be reported in Chapter Seven below, for comparative purposes and because the problems of estimating these relationships seem themselves to be somewhat revealing of the relationship among product, imports and investment. This point will be further discussed in Chapter Seven.

In summary, the Linder-Chenery hypothesis is predictive of a negative relationship between imports and gross domestic product; the standard hypothesis of a positive relationship. The Linder-Chenery hypothesis is predictive of a positive relationship between imports and investment, while the standard hypothesis predicts no relationship.

II

Among the problems often encountered in time series regression analysis are multicollinearity⁶ and autocorrelation of the errors.⁷ Multicollinearity exists when there is a linear relationship among the exogenous variables. When an exact linear relationship exists among the exogenous variables, the regression coefficients cannot be estimated; and when the relationship is not exact but approximate,

⁶See E. Malinvaud, Statistical Methods of Econometrics (Amsterdam, North-Holland Pub. Co., 1966) pp. 187-92, J. Johnston, Econometric Methods (New York: McGraw-Hill, 1963), pp. 201-207, D. Huang, Regression and Econometric Methods (New York: Wiley, 1970) pp. 149-158.

⁷See Malinvaud, op. cit., pp. 77, 420-648; Johnston, op. cit.; Ch. 7.; Huang, op. cit., pp. 135-146.

the estimates of the regression coefficients are rather highly uncertain. This uncertainty is expressed as large estimated standard deviations of the regression coefficients.⁸ There are two important sources of multicollinearity in economic time series. First, national accounts data usually display trends over time, and these trends may be similar. Insofar as the exogenous variables are subject to similar trends, this would produce some correlation among them. Second, there may be causal relationships among the "independent" variables which are not considered in the regression model. Autocorrelation of the errors is serial correlation between the current year's error term and error terms for previous years. Such errors might result from the omission of an exogenous variable which does affect the endogenous variable. The effect of the omitted exogenous variable would be a component of the error term. The effect might persist over several years.⁹ A special case of the excluded variable would be the lagged value of the endogenous variable itself, where lags enter the true relationship.

Multicollinearity cannot be remedied, but in this study it proves to be of little concern, as the results obtained are precise enough to give rise to some positive conclusions.

It is possible to adjust time series data to eliminate the autocorrelation in the errors, in case the errors follow a simple

⁸See Malinvaud, op. cit., pp. 187-192.

⁹See Malinvaud, op. cit., p. 420.

autoregressive scheme.¹⁰ The hypothesis that there is no autocorrelation in the errors can be tested by the use of the Durbin-Watson statistic computed on the residuals of the least-squares regression.¹¹ Then, following Theil and Nagar,¹² in case the true relation is

$$\begin{aligned}
 13. \quad Y_t - \rho Y_{t-1} &= A + B_1 X_{1t} + \dots + B_n X_{nt} + u_t - \rho A - \rho B_1 X_{1t-1} \\
 &\quad - \dots - \rho B_n X_{nt-1} - \rho u_{t-1} \\
 &= (1-\rho)A + B_1(X_{1t} - \rho X_{1t-1}) + \dots + \\
 &\quad B_n(X_{nt} - \rho X_{nt-1}) + \rho u_{t-1} - \rho u_{t-1} + u_t
 \end{aligned}$$

Thus, a linear regression run on $Y_t - \rho Y_{t-1}$, $X_{1t} - \rho X_{1t-1}$, ..., $X_{nt} - \rho X_{nt-1}$ should give a correct estimate of the B_1 , ..., B_n and permit estimation of A . Further, the errors in the adjusted series should be serially independent, as the u_t are by assumption. Once the regression has been run on the adjusted data, the residuals of that regression can again be tested for serial correlation by the Durbin and Watson statistic. If significant serial correlation is indicated, then the assumption of the simple autoregressive scheme 14. was evidently in error. A further adjustment can be tried on the hypothesis of a two-term error process, or an altogether

¹⁰See Johnston, op. cit., p. 194. H. Theil and H. L. Nagar, "Testing the Independence of Regression Disturbances," Journal of the American Statistical Association, LVI (Dec. 1961), pp. 793-806.

¹¹J. Johnston, op. cit., p. 192.

¹²Op. cit.; also Henshaw, "Testing Single-Equation Least-Squares Regression Models for the Autocorrelated Disturbances," Econometrica, XXXIV, 3 (July, 1966), pp. 646-660. See p. 655.

different error process may be assumed.¹³

III

Economic data derived from national statistical offices, such as those used here, are without question subject to errors from a number of sources.¹⁴ Errors in the data may be of either of two kinds: systematic or random. Systematic errors would be persistent over long periods of time, perhaps through the entire period of the data series. In the latter case they will be undetectable; if they do not persist through the entire period, however, they will introduce some autocorrelation of the errors. In any case there is nothing to be done about them. The measured data of gross domestic fixed capital formation, gross domestic product, and imports of goods and services are fair proxies for the categories on which the theory is based, at best. In some cases¹⁵ still rougher proxies have in fact been used, with adequate results.

Random errors in the data on the independent variables are contrary to the assumptions of the least-squares method, which was in fact used.¹⁶ They introduce a bias toward zero in the correlation

¹³For example, where there is reason to suppose the data are noncomparable over the entire time series, a dummy variable might be inserted which is zero for one series and one for the other. This was tried in some cases but without useful result.

¹⁴See O. Morgenstern, On the Accuracy of Economic Information, 2nd Ed. (Princeton, N. J.: Princeton University Press, 1953). Ch. II, VI, IX, X, XIV.

¹⁵See the notes to Table One, Chapter Seven below.

¹⁶See Malinvaud, op. cit., p. 75.

coefficients and in the simple regression coefficients.¹⁷ Unfortunately, random errors in the data do not in every case bias the partial regression coefficients in multiple regression analysis toward zero,¹⁸ since if they did, they could be ignored for the purposes of this study. The reason is that the hypotheses under test can be disconfirmed only by estimates which are significantly different from zero in any case, and such results were often obtained. The conclusions on the validity of the models would not be affected by any underestimates. In fact, however, there is no alternative to ignoring the errors in the data. Computational methods exist for use with data subject to errors but they require a knowledge of the distribution of the errors.¹⁹ No such knowledge was available for use in this study. Probably errors in the data will generally bias the estimates of regression coefficients toward zero (since the values of the dependent variable which are above the mean, as measured, will tend to be overestimated, while those below the mean, as measured, will tend to be underestimated).²⁰ Thus it seems unlikely that errors in the data will produce spuriously significant estimates.

It is the possibility of bias, in particular downward bias,

¹⁷See Malinvaud, op. cit., pp. 332-334.

¹⁸See K. Fox, Intermediate Economic Statistics (New York: Wiley, 1968), p. 249 for a numerical example.

¹⁹Reference is to the weighted regression model. See Malinvaud, pp. 335-347.

²⁰See D. Huang, op. cit., pp. 160-161.

in the regression coefficients that renders the magnitude of $\frac{1}{a}$ in equation 5. and $\frac{1}{b}$ in equation 6. unsuitable as criteria for the rejection of the Linder-Chenery hypothesis. In the estimate of Model 1., for example, an estimate of B_2 which is significantly less than one would be reason for rejecting the Linder-Chenery hypothesis, if the errors in the data were negligible. Now, suppose that B_2 were also significantly greater than zero, to the same level of confidence. This would be reason for rejecting both the null hypothesis of no relationship and the "standard hypothesis." Certainly some other hypothesis, not considered here, might account for such a value of B_2 , but, allowing for the likelihood of errors in the data, downward bias must also be considered possible. Thus the study reported in the next chapter will concentrate on the signs, not the magnitudes, of the regression coefficients as criteria for the rejection of hypotheses.

IV

In summary, the estimates of the chapters which follow were calculated by the method of least squares on time series data. Like many time series, it is unlikely that they fulfill completely the assumptions on which the least squares method is based. However, for a variety of reasons already considered, the results seem adequate to the purposes of this paper.

CHAPTER 7

THE EMPIRICAL STUDY

This chapter reports the linear regressions run on data for eleven Latin American countries and Puerto Rico. The first section is concerned with the estimates themselves, while the second section is concerned with some of the problems of estimation encountered, and the third adds some interpretive comments with respect to individual countries. The last section of this chapter is a summary. The appendices which follow present the data used in the regressions, and the simple correlation coefficients, in tabular form.

I

The data used in the regressions represented investment, imports, and gross domestic product in each of the countries shown in Table One. The source from which the data were drawn, the units of measurement, and the years for which data were available for this study are also shown. With one exception, all data were expressed in terms of constant prices for the year shown in the table. The exception is Venezuela. In the case of Venezuela, no series of data on imports, in terms of constant prices, was available which is long enough for the purposes of this study. However, Venezuela is of particular interest from the point of view of the two-gap theory, since it is an exporter of oil. Evidence of a trade gap in a

country possessed of such a dynamic export sector as petroleum would be of particular interest. Thus, regressions were estimated for Venezuela based upon constant-price data for gross domestic product

TABLE 1
SOURCES AND UNITS OF MEASUREMENT FOR THE DATA

country	source	units of measurement	at prices of	for years
Argentina	OECD	billions of pesos	1960	1950-66
Brazil	OECD	billions of cruzieros ¹	1953	1947-66
Chile	GWl, OECD	millions of escudos ²	1960	1950-67
Colombia	OECD	millions of pesos	1958	1950-65
Ecuador	UNYB	millions of sucres	1960	1950-67
Guatemala	GWl, UNYB	millions of quetzales	1958	1950-65
Honduras	GWl, UNYB	millions of lempiras	1958	1948, 1950-67 ³
Nicaragua	UNYB	millions of cordobas	1958	1953, 1955-66 ³
Paraguay	UNYB	millions of guaranies ⁴	1962	1950, 1953, 1955-67 ³
Peru	OECD	millions of soles ⁵	1950-67	1963
Puerto Rico	UNYB	millions of dollars	1951-67	1963
Venezuela	OECD	millions of bolivares	1950-66	1957 ⁶

Legend: OECD denotes National Accounts of Less Developed Countries, 1950-66, Development Center, Organization for Economic Cooperation and Development (Paris, 1968); GWl denotes Growth of World Industry, 1938-61, United Nations (New York, 1963). UNYB denotes various issues of the United Nations Yearbooks of National Accounts Statistics (New York).

¹Data for imports include net factor income to abroad.

²Data for 1961-67 not necessarily comparable to earlier data.

³As the time series is disjoint, the noncontiguous observations had to be dropped when adjustments were made for the apparent autocorrelation of the errors. As in all other cases, time is measured in years elapsed from 1950.

⁴Investment includes change in stocks.

⁵Data for imports include gross income to abroad. Product data are gross national product.

⁶Import data are in current prices. Data for 1950-59 and 1960-66 are not necessarily comparable.

and investment together with current-price data on imports, in hopes of capturing some hint of a relationship.

The regressions of primary interest are those for model 1. The estimated regression coefficients, standard errors of the regression coefficients, coefficients of determination, standard errors of the estimate, and Durbin-Watson statistics are given in Table Two. The significance levels of the regression coefficients and standard errors of estimates, and of the Durbin-Watson statistic, are given in the footnotes to the table. Notice that the standard errors are indefinitely underestimated, and the significance levels overestimated, except for the Durbin-Watson statistic, in the case of Venezuela. This follows from the presence of autocorrelated errors, as indicated by the significance of the Durbin-Watson statistic, in this case.¹

Model 1. assumes

$$I = A + B_1 t + B_2 M + B_3 \text{GDP} + \epsilon$$

where I is investment, t is time measured in years elapsed from 1950, M is imports, GDP is gross domestic product, and ϵ is an error term. The Linder-Chenery hypothesis leads one to expect that

$$1) \quad B_2 > 0$$

$$2) \quad B_3 < 0;$$

in addition there is some reason to expect that $B_2 > 1$; however, discussion of this point is deferred to the next section.²

The "standard" hypothesis leads one to expect the following:

¹See J. Johnston, Econometric Methods (New York: McGraw-Hill, 1963), pp. 192-195.

²The point is deferred because it relates to the problem of errors in the data.

TABLE 2
MODEL 1 ESTIMATES

	A	B ₁	B ₂	B ₃	R ²	Standard error of the estimate	D
Argentina	3.84213	3.15324 (3.84527)	1.33999** (0.36776)	0.00016 (0.15299)	0.8759**	15.49592	2.047983
Brazil+	84.333416	-3.73865 (2.44619)	1.22143** (0.28710)*	0.25828* (0.11857)	0.8366*	6.47574	1.99453
Chile	191.01788	0.96213 (5.13918)	-0.04855 (0.08528)	0.06123* (0.02798)	0.8446*	25.53615	2.4935
Colombia	365.09387	81.52384 (137.11949)	0.96224** (0.10639)	-0.04655 (0.14963)	0.9259**	226.97392	2.07667
Ecuador	1769.367	126.96484** (39.33737)	0.64957** (0.15025)	-0.20236** (0.05846)	0.9648**	88.47316	2.01786
Guatemala	98.61632	1.69145 (3.10757)	1.11396** (0.23685)	-0.17145* (0.08260)	0.8733**	13.90569	1.98773

TABLE 2 -- Continued

	A	B ₁	B ₂	B ₃	R ₂	Standard error of the estimate	D
Honduras	24.05037	0.31880 (1.23140)	0.46658** (0.08808)	-0.03220 (0.07873)	0.9459**	6.02411	1.78885
Nicaragua	-263.62505	-22.00171* (9.40686)	0.08061 (0.33585)	0.31505 (0.15331)	0.9706**	29.30444	2.67999
Paraguay	-753.53509	-24.73828 (209.17513)	0.88760** (0.19511)	0.02230 (0.13714)	0.8415*	737.98853	2.20627
Peru	7676.34394	-71.18359 (256.81641)	1.19353** (0.19656)	-0.18017 (0.11502)	0.9382**	944.96973	2.1029
Puerto Rico	-163.61527	-14.18774* (4.90170)	0.31273* (0.16584)	0.16975 (0.10180)	0.9934**	19.92534	2.6041
Venezuela ⁺⁺	5801.65637	243.33594 (539.40698)	0.94632** (0.31309)	-0.32784 (0.44301)	0.6784*	558.14551	0.8451*

*Significant at .05.

**Significant at .01.

+Adjusted to eliminate serial correlation of the residuals.

++In the case of Venezuela, the errors are evidently autocorrelated, and thus the standard errors are underestimated and the significance levels overestimated to an uncertain degree.

$$3) \quad B_2 \approx 0.$$

$$4) \quad B_3 > 0.$$

Thus it would appear that the "standard" hypothesis is rejected at a given level of confidence if $B_2 > 0$, $B_2 < 0$, or $B_3 < 0$ significantly at that level of confidence. Since $B_3 < 0$ at a 5% confidence level or better in two cases only, and in both of those cases also, $B_2 > 0$ at a 1% confidence level, no more will be said about the cases in which B_3 is significantly negative. Similarly, the Linder-Chenery hypothesis would seem to be rejected at a given level of confidence whenever either $B_2 < 0$ or $B_3 > 0$ significantly at that confidence level. Since there is no case in which $B_2 < 0$ at the 5% confidence level, this hypothesis will be ignored henceforth. We now have,

$$5) \quad \text{Hypothesis } H_1: \quad B_2 \leq 0,$$

$$6) \quad \text{Hypothesis } H_2: \quad B_3 \geq 0,$$

together with the null hypothesis,

$$7) \quad \text{Hypothesis } H_3: \quad B_1 = B_2 = B_3 = 0.$$

Notice that it is possible to reject all three hypotheses simultaneously. Indeed, in the case of Brazil, all are rejected at the 5% confidence level, since $B_2 > 0$, $B_3 > 0$, and the F test on the regression for Brazil indicates that the R^2 of 0.8366 is significant at the 5% level of confidence. The F test is a test of hypothesis H_0 , which is rejected at a given confidence level when R^2 is significant at that level.³

For present purposes, then, the standard hypothesis is to be

³See K. Kane, Economic Statistics and Econometrics (New York: Harper & Row, 1968), p. 269.

identified with hypothesis H_1 , and the Linder-Chenery hypothesis with hypothesis H_2 , in the sense that whenever H_1 is rejected the standard hypothesis is disproven, and whenever H_2 is rejected, the Linder-Chenery hypothesis is disproven. Venezuela is excluded from the testing for the reasons mentioned above.

It is now possible to state the results rather concisely.⁴ In the eleven cases tested, at the 5% confidence level, the null-hypothesis was rejected in every case. At the 5% level also, the "standard" hypothesis was rejected in every case except those of Chile and Nicaragua, while the Linder-Chenery hypothesis was rejected in the cases of Brazil and Chile. Only the null-hypothesis was rejected in the case of Nicaragua, while in the case of Nicaragua, B_1 was significantly positive at the 5% confidence level. Thus, at the 5% level of confidence, the results are consistent with the Linder-Chenery hypothesis and inconsistent with the standard hypothesis in the following cases: Argentina, Colombia, Ecuador, Guatemala, Honduras, Paraguay, Peru, and Puerto Rico. The results are inconsistent with the Linder-Chenery hypothesis and consistent with the standard hypothesis in the case of Chile, are inconsistent with both hypotheses in the case of Brazil, and are consistent with both hypotheses in the case of Nicaragua.

At the 1% confidence level, the results are naturally somewhat more equivocal. There is no case in which H_2 can be rejected at the 1% confidence level. It remains possible to reject H_1 in every case

⁴These results are, however, qualified because of the likelihood of errors in the data. See the next section on this point.

but Chile, Nicaragua, and Puerto Rico. The null hypothesis is rejected in every case but Brazil, Chile, and Paraguay. The following cases are consistent at the 1% level with the Linder-Chenery hypothesis and inconsistent at that confidence level with either the standard or null-hypothesis: Argentina, Colombia, Ecuador, Guatemala, Honduras, and Peru. The cases of Brazil and Paraguay are inconsistent with the standard hypothesis, but consistent with either the Linder-Chenery hypothesis or the null-hypothesis, at the 1% level. The cases of Nicaragua and Paraguay are inconsistent with the null hypothesis, and no conclusion can be drawn in the case of Chile, at the 1% level.

In plainer terms, it would seem that imports have effectively constrained investment during the period under study in six of the eleven countries, namely Argentina, Colombia, Ecuador, Guatemala, Honduras and Peru. The evidence for such a constraint is less clear, but favorable, in the cases of Paraguay and Puerto Rico. The evidence is still more equivocal in the case of Brazil, but it would seem rather more favorable than unfavorable. Chile has evidently not been effectively constrained by limited capacity to import during the period under study. No conclusion is possible in the case of Nicaragua. It seems worth recalling at this point that the data on imports are wrongly reported (for the purposes of this study) in the cases of Brazil and Peru, while those for investment are wrongly reported in the case of Paraguay. Thus poor results might have been expected in the case of Brazil and Paraguay.

In a number of cases, one or more of the regression

coefficients in model one is insignificantly different from zero at the 5% level of confidence, so that one might be interested in the results of a more restrictive specification. Consider, for example, the case of Argentina. In model 1, neither B_1 nor B_3 is significantly different from zero at the 5% confidence level. Thus, at that confidence level, these results are consistent with the hypothesis that $B_1 = B_3 = 0$, and thus $I = A + B_2M$. Thus it may be of interest to compare an estimate based on that assumption with the model 1 regression. The estimate of the model based on the assumption that $B_1 = B_3 = 0$, that is, model 3, is given in Table Three, Respecifications. In each case where there is some reason to suppose that a more restrictive model might be appropriate, along the line of reasoning given above, the estimate for the appropriate model is entered in Table Three for comparison. It was judged appropriate to report model 2 ($B_1=0$) in the cases of Brazil, Guatemala, Nicaragua, Peru and Venezuela; those of model 3 in the cases of Argentina, Colombia, Honduras, and Paraguay, and that of model 4 in the case of Chile.

The models which made gross domestic product the dependent variables gave rise to less successful estimations, both in the sense that few of the estimates make it possible to reject any hypothesis whatever, and in other senses which will be explored in the next section. Multicollinearity seems to have been one important reason for the failure of the model 5 and model 6 regressions.⁵ The

⁵The simple correlation coefficients are given in Tables Thirteen through Twenty-four of the Appendix to this chapter. In most cases, the partial correlation coefficient of imports and investment is usually on the order of 0.9 or higher; indeed this is what the trade gap hypothesis leads us to expect.

TABLE 3
RESPECIFICATIONS

	Model	A	B ₂	B ₃	R ²	Standard error of estimate	D
Argentina	3	-30.11713	1.92018** (0.25872)		0.7860	18.9469	1.4885
Brazil	2	-9.769531	1.00900** (0.28428)	0.07750** (0.01845)	0.7378*	6.70189	1.9138
Chile	4	195.17017		0.05559** (0.00604)	0.8410	24.16264	2.3936
Colombia	3	-438.57813	1.06557** (0.10845)		0.8734	274.64453	1.5085
Ecuador	None						
Guatemala	2	78.75439	1.11978** (0.23011)	-0.13891* (0.05545)	0.8702**	13.52391	1.94713
Honduras	3	14.85977	0.42411** (0.02481)		0.9450*	5.70752	1.6574
Nicaragua	2	46.65576	0.48160* (0.20211)	0.00446 (0.09220)	0.9527**	35.25745	1.72268
Paraguay	3	-168.16406	0.90530** (0.10921)		0.8409*	680.06616	1.9886
Peru	2	8528.49609	1.20920** (0.18147)	0.20677** (0.06113)	0.9378**	910.93994	2.0991
Puerto Rico	None						
Venezuela ⁺⁺	2	3626.87036	0.83173** (0.17772)	0.12899** (0.0424)	0.6733	542.04272	0.7566

*Significant at .05.

**Significant at .01.

+Adjusted to eliminate serial correlation of the residuals.

++In the case of Venezuela, the errors are evidently autocorrelated, and thus the standard errors are underestimated and the significance levels overestimated to an uncertain degree.

standard errors of the estimates tend to be large by comparison with the estimates of B_2 and B_3 , and this can in some cases result from multicollinearity.⁶ Indeed, to the extent that imports is a good predictor of investment, multicollinearity is to be expected. Nonetheless, the estimates of model 5 have some implications which are of importance here, and thus they are presented for comparison in Table Four.

The results obtained are of interest primarily in the cases of Nicaragua and Venezuela. In those cases, as in the case of Puerto Rico, estimates based on the raw data proved free of significant serial correlation in the residuals, as indicated by the Durbin-Watson statistic D. In the case of Nicaragua, the result obtained is inconsistent with the Linder-Chenery hypothesis at the 5% confidence level, although they are also inconsistent with the "standard" hypothesis. In the case of Venezuela, the data are inconsistent with the null hypothesis and with the standard hypothesis, and consistent with the Linder-Chenery hypothesis.

II

This section will be concerned with the problems which were encountered in the estimation of the models, and with the qualifications with regard to the interpretation of the data which follow from them. The implications of errors of measurement will be considered first. Second, consideration will be given to the probability of autocorrelation of the errors, and some possible sources of

⁶E. Kane, op. cit., p. 278.

TABLE 4
MODEL 5 ESTIMATES

	A	B ₁	B ₂	B ₃	R ²	Standard error of estimate	D
Argentina ⁺	530.196089	15.95709** (2.01170)	0.84798 (0.88957)	0.61962 (0.55192)	0.9465**	27.66362	1.7258
Brazil ⁺	723.645286	9.18802** (0.50065)	-0.71062 (0.56749)	0.84373* (0.33442)	0.9684**	10.27169	1.6452
Chile ⁺	1333.7177	90.82539 (21.43436)	0.36524** (0.65810)	2.72723 (1.60854)	0.9257**	105.68709	1.6243
Colombia ⁺	11628.056772	162.97192** (29.63322)	0.01710 (0.35620)	0.01275 0.34032	0.8674*	329.25146	2.1095
Ecuador ⁺	8351.402119	403.86206** (41.07123)	1.17867* (0.62116)	-1.55409* (0.72210)	0.9852**	285.35547	1.7458
Guatemala ⁺	489.059071	14.06389** (2.86927)	2.14237** (0.61634)	-0.72019 (0.54889)	0.9546**	26.11197	2.6320

TABLE 4 - Continued

	A	B ₁	B ₂	B ₃	R ²	Standard error of estimate	D
Honduras ⁺	140.888661	3.57242** (0.94515)	0.34700 (0.35469)	0.87921 (0.50593)	0.8478*	14.04543	2.2287
Nicaragua	988.9547	58.47290** (8.81928)	0.94495** (0.29732)	1.01334* (0.49297)	0.9950**	52.53781	2.6978
Paraguay ⁺	33076.606765	709.92896** (83.95856)	-0.14217 (0.54373)	0.66340 0.60531	0.9271**	923.26929	2.0446
Peru ⁺	3372.076372	100.76305** (21.43948)	0.89275 (0.58386)	-0.28740 (0.43674)	0.9405**	165.08029	1.8042
Puerto Rico	327.18719	4.08203 (15.84303)	0.94839* (0.38934)	1.06714 (0.64280)	0.9964**	50.17967	2.5093
Venezuela	11192.4375	1192.53125** (41.75845)	0.69961** (0.15831)	-0.12331 (0.16639)	0.9981**	341.83936	1.9789

*Significant at .05.

**Significant at .01.

+Adjusted to eliminate serial correlation of the residuals.

++In the case of Venezuela, the errors are evidently autocorrelated, and thus the standard errors are underestimated and the significance levels overestimated to an uncertain degree.

autocorrelated errors will be considered in the light of the pattern in their apparent occurrence in this study. In that connection, two possible specification errors will be considered as well.

The usual practices of national statistical offices, together with simple human fallibility, may be sources of errors of measurement in macroeconomic time series.⁷ The particular case of Brazil offers an example in this regard. In addition to the usual problems of inadequate or unreliable data, the constant-price aggregates are based on "moving weights and chain indices," which, although it "facilitates the incorporation of new statistical information (especially on recently created economic activities)," among other possible advantages, its validity may be doubted "to the extent that the various weighting years do not correspond with 'normal' years."⁸ Errors of measurement introduced in this way would, moreover, be autocorrelated, a point which will be considered further below. In addition, in some cases as noted above, it has been necessary to use data which were not defined as the theory would require, because the proper data were not available.

When there are errors of measurement in the independent variables, the estimates of the regression coefficients are biased.⁹

⁷O. Morgenstern, On the Accuracy of Economic Information, 2nd Ed. (Princeton, N. J.: Princeton University Press, 1963), Chs. II, VI, IX, X, XIV.

⁸National Accounts of Less-Developed Countries, Organization for Economic Cooperation and Development (Paris, 1968). Also note Morgenstern, op. cit., on "normal" years.

⁹See Malinvaud, Statistical Methods of Econometrics (Amsterdam: North-Holland Pub. Co., 1963), pp. 332-334.

When there is only one independent variable, the bias of its regression coefficient is always toward zero, however.¹⁰ The principle is set out by Friedman¹¹ in his argument that consumption-function regressions with current income as the independent variable understate the true propensity to consume. Now, if one of the hypotheses H_1 and H_2 is rejected on the basis of an estimate biased toward zero, it would be rejected on an unbiased estimate as well. Unfortunately, when there are two or more independent variables, the direction of bias is indeterminate.¹² There being some possibility of a bias away from zero, or even of a reversal of sign due to bias, some doubt is necessarily cast on the conclusions drawn in the last section. However, this doubt is dismissed (tentatively as must be the case) for the following reasons: first, there is some a priori reason to suppose that the values of B_2 in Table Two are in fact somewhat biased toward zero in case the Linder-Chenery hypothesis is indeed valid; for recall that model 1 is derived from

$$8) \quad I = \frac{1}{a}M - \frac{b}{a}Y - g, \text{ where } a \leq 1, b \leq 1.$$

B_2 is an estimate of $\frac{1}{a}$. Thus if $a \leq 1$, then $B_2 \geq 1$. In fact, the estimates of B_2 are, as Table Two shows, mostly on the order of one. Indeed, in five cases the estimates are significantly less than one: Chile, Ecuador, Honduras, Nicaragua, and Puerto Rico.

¹⁰Malinvaud, loc. cit.

¹¹M. Friedman, A Theory of the Consumption Function (New Jersey: Princeton University Press, 1957).

¹²Malinvaud, loc. cit.

The cases of Chile and Nicaragua may be dismissed for the moment, but the other three cases deserve further attention. The estimates for Ecuador, Honduras and Puerto Rico seem, otherwise, to support the Linder-Chenery hypothesis. If that hypothesis is rejected because the estimates of B_2 are significantly less than one, then these three cases would join Brazil in the enigmatic category, that is, they would then be contradictory of all hypotheses under test. However, these strange results might also be attributed to bias due to errors in the independent variables. If so, then what are the true values? In the case of Ecuador, the model 5 estimates (Table Four) and the significantly negative value of B_3 seem to support the Linder-Chenery hypothesis. In the case of Honduras, the model 3 respecification (Table Three), which agrees with the model 1 estimate of B_2 , would be biased toward zero if at all. However, in the case of Puerto Rico the supporting evidence is less clear (Model 5), while in the case of Brazil, they are broadly unfavorable to the Linder-Chenery hypothesis. In the other cases which have been interpreted as favoring the Linder-Chenery hypothesis, the estimates of B_2 in Table Two would lead one to suppose that b in equation 8) is on the order of one in every case, but again that needs not be so since the estimates of B_2 are probably biased toward zero. Thus $B_2 > 1$ is possible and so is $b = \frac{1}{B_2} < 1$.

Had information been available on the distribution of the errors of measurement, then an unbiased estimate could have been made by weighted regression.¹³ However, no such information was

¹³ Malinvaud, op. cit., pp. 335-347.

available.

The least squares regression model assumes that the error term for each observation is independent of the other error terms, but this is often not so in the case of economic time series. In economic time series, disturbances often result from the influence of variables not taken into account in the regression equation, and these influences may persist from year to year. Thus it is necessary to test the time series estimates to determine whether the assumption of serial independence of the errors is fulfilled.

Several approaches exist to testing for serial correlation of the errors.¹⁴ The statistic most often used is the Durbin and Watson statistic which is given in the tables. The tables of Durbin and Watson give significance points for the statistic, which make it possible for small enough values of the Durbin and Watson statistic to reject the hypothesis that the errors are serially independent, and for values of the statistic which approximate two, to state that the hypothesis cannot be rejected (for either 5% or 1% confidence levels). There is, however, a "region of uncertainty" within which it is impossible to say whether the hypothesis of serial independence must be rejected or not. Durbin and Watson propose an approximative procedure to determine calculate the significance of those cases that lie within the "region of ignorance."¹⁵ Theil and Nagar give

¹⁴R. Henshaw, "Testing Single-Equation Least Squares Regression Models for Autocorrelated Disturbances," Econometrica, XXXIV, 3 (July, 1966), pp. 646-660. See pp. 653-655.

¹⁵J. Durbin and G. Watson, "Testing for Serial Correlation in Least Squares Regression II," Biometrika, XXXVIII (1951), pp.159-178.

approximate significance limits on the assumption that the first-differences of the errors are "small" relative to the range of the variables, but unfortunately they do not say what "small" means.¹⁶ Henshaw proposes an exact test along the lines of Theil and Nagar's test, but that test requires computation which was infeasible given the programming limitations to which this study was subject.

Fortunately, the problem was small in the case of model 1. Only one of the regressions in model 1 gave rise to a Durbin-Watson statistic which fell in the uncertain region. By the test of Theil and Nagar, the hypothesis of no serial correlation of the residuals was rejected at the 5% confidence level in the case of Brazil, and the regression shown for Brazil, as noted, is adjusted by a procedure which was explained in the last chapter. However, given the approximate character of the Theil and Nagar test, it seems proper to present the original regression for Brazil, and it follows:

$$A = 60.92512; B_1 = -5.69043^*; B_2 = 1.36501^{**}; B_3 = 0.26263^{**}$$

$$(2.85122) \quad (0.25877) \quad (0.09193)$$

$$R^2 = 0.9259^{**}, \text{ std. error of the estimate} = 6.63360, D = 1.43451.$$

As regards the substantive conclusions drawn before, this estimate does not differ from the adjusted one. This estimate, too, leads one to reject all of the three hypotheses considered, at the 5% (and at the 1%) level of confidence.

The problem was rather more serious in the case of the model 5 regressions. With the exceptions of Nicaragua, Puerto Rico and

¹⁶H. Theil and A. L. Nagar, "Testing the Independence of Regression Disturbances," American Statistical Association Journal, LVI, (Dec. 1961), pp. 793-806.

Venezuela the model 5 regressions yielded Durbin-Watson statistics which were at least doubtful at the 5% confidence level. Making full reliance on the approach of Theil and Nagar despite its shortcomings, the data were adjusted to eliminate the effects of autocorrelated errors and regressions were run on the adjusted data. In the cases of Brazil, Chile and Peru, the first adjustment did not eliminate the significant serial correlation of the residuals, so that a second adjustment term was introduced, and a third regression calculated. In the cases of Brazil and Peru, it is the twice-adjusted regression which is shown. In the case of Chile, the second round resulted in a worse Durbin-Watson statistic, and the once-adjusted equation is shown.

A special case is model 1 in the case of Venezuela. The Durbin-Watson statistic indicated significant serial correlation of the errors at the 5% confidence level according to the tables of Durbin and Watson. Attempted adjustment of the data did not eliminate the evidence of serial correlation, and thus the original regression has been given, with caveats. In the cases of Chile and Venezuela, a dummy variable was tried which was zero before the shift in the basis of the data and was one afterward, but in no case did this improve the results obtained.

Evidently the model 5 equations were far more subject to autocorrelation of the errors than were the model 1 and related equations. The balance of this section will be given to speculation as to why that might be so. Two hypotheses suggest themselves which might account for the greater degree of autocorrelation of the errors in

the model 5 regressions than existed in the model 1 regressions. The first hypothesis relates to the errors of measurement in the independent variables, and the second relates to forces which might affect gross domestic product, but are not taken into account in the model 5 equations, and would not affect investment. Such forces would tend to produce autocorrelated errors in the model 5 equations, but not in the model 1 equations.

It has been pointed out that errors of measurement are to be expected in the data derived from national statistical offices.¹⁷ It may be that these errors will be autocorrelated to some degree. As noted above, this is certainly the case with respect to the Brazilian data. Furthermore, it may be that the errors of measurement will be more pronounced in the case of the gross domestic product data than in the case of the other data, for most countries. The reason for this is the "dualistic" character of underdeveloped countries. Suppose that the country has a "modern" sector which is relatively well measured and a "traditional" sector for which few data exist. Suppose moreover that economic activity which enters into international trade is generally well accounted for. Thus the errors in the measurement of imports would be fairly small, and insofar as capital goods are either imported or originate in the traditional sector, investments too would be relatively exactly counted. However, for those activities which take place entirely in the traditional sector, some rather rough guesses might have to be used, and these

¹⁷Morgenstern, op. cit., loc. cit.

guesses might well enter into the gross domestic product data in such a way as to cause autocorrelated errors.

Now, let the errors of measurement in imports and investment be neglected entirely. Suppose that the true relation is

$$9) \quad I = A_1 + B_1 t + B_2 M + B_3 X + \epsilon(t)$$

$$X = GDP + u(t)$$

$$u(t) = \rho u(t-1) + \eta(t),$$

where $u(t)$, $\epsilon(t)$, and $\eta(t)$ are error terms. Notice moreover that, in equation 8) above, $B_3 = \frac{b}{a}$, where b is the proportion of necessary inputs in gross domestic product and a is the proportion of necessary inputs in investment. Roughly classifying capital goods as outputs of the "modern sector" as before, it seems plausible that $a > b$ by a substantial margin.¹⁸ Thus B_3 would be less than one. Equation 9) becomes

$$10) \quad I = A_1 + B_1 t + B_2 M + B_3 GDP + u'(t)$$

where $u'(t) = B_3 u(t) + \epsilon(t) = \rho B_3 u(t-1) + B_3 \eta(t) + \epsilon(t)$. Thus the autocorrelated error is only a part of the total error and the autoregression constant is $\rho B_3 < \rho$. In the case of model 5,

¹⁸ M. Merhav gives data on the share of imports of capital goods for 24 countries, including Ireland, Israel, Portugal and South Africa among underdeveloped countries. The estimates, from U. N. sources, range from 22 to 53% in 1950-1, and from 18 to 55% in 1958-9. The mean is 35.5 in 1950-1 and 36.0 in 1958-9. See Technological Dependence, Monopoly, and Growth (London: Pergamon Press, 1969). These would imply that B_2 should be approximately 3 in many cases. However, these figures may be underestimates, since imported capital goods may not be machinery. Blooded cattle come to mind as an example. Furthermore, domestically produced capital goods may require imported semifinished or raw materials and replacement parts. These might to some degree escape the United Nations figures quoted by Merhav.

we have

$$11) \text{ GDP} = A'_1 + B'_1 t + B'_3 I + \varepsilon'(t) - u(t)$$

where, as before, $u(t) = \rho u(t-1) + \eta(t)$.

In eleven, the autoregressive part of the error is greater proportionately as one is greater than B_3 . This might explain the more frequent occurrence of significant serial correlation in the residuals (at the 5% level) in model 1 than would be the case in model 5.

A second hypothesis relates to forces unaccounted for thus far which might enter into model 5 but not into model 1. These forces might be of a number of kinds, but an obvious possibility is that forces of aggregate demand might be among the determinants of gross domestic product. Suppose that in addition to equation 8), we have the conventional aggregate-demand structure,

$$12) \text{ Y} = \text{C} + \text{I} + \text{G} + \text{E} - \text{M},$$

$$13) \text{ C} = \text{C}_0 + cY,$$

Where C is consumption, G government expenditure, E exports, C_0 autonomous consumption, and c the marginal propensity to consume. Now I, Y, and C would be determined simultaneously, as usual. This would mean 1) that an explicit simultaneous-equations model would be the appropriate approach to estimation. This point will be developed further in the next chapter. 2) An identification problem is implied with respect to model 5), although not with respect to model 1.¹⁹ 3) G and E would enter into model 5 as error terms, and

¹⁹ See Huang, Regression and Econometric Methods (New York: Wiley, 1970), p. 215, for a very close analogy in connection with estimating supply and demand functions. Because exports and

they may very well be serially correlated. However, insofar as 12) is a correct relationship, G and E would enter into model 1 primarily as determinants of gross domestic product. Unless 12) and 13) are relationships which are actually without error terms, another source of bias in the estimates of model 1 is implied, as the errors would not be independent of gross domestic product, an independent variable in model 1.²⁰ Although equation 12) an identity, might be exact, equation 13) is hardly likely to be exact, and moreover errors of measurement would render even the identity, equation 12), exact.

The existence of two equally plausible explanations for the relatively intransigent problem of autocorrelated errors in the model 5 regression, as against those of model 1, underscores the need for further research using more sophisticated hypotheses. This point is further developed in the next chapter.

and government expenditure enter into the determination of gross domestic product via aggregate demand, GDP can be expected to vary somewhat independently of M and there is no structure which is observationally equivalent to model 1. However, taking

$$1. \quad Y = \frac{1}{1-c} (C_o + I + G + E - M)$$

and 2. $kI = k(\frac{1}{a}M + \frac{b}{a}Y + g)$, then

$$3. \quad Y = \frac{1}{1-c+(kb/a)} (C_o - kg + (1+k)I + G + E - (1 + \frac{k}{a})M),$$

which is observationally equivalent to 1. for any k.

²⁰Huang, op. cit., p. 209.

III

This section will give some comments on the results in the cases of selected individual countries, in alphabetical order.

The example of Argentina is of particular interest not only because Argentina is a large, important Latin American country but also because the existence of a trade gap has been specifically argued in the case of Argentina in the context of a much more complete model of the Argentine economy by Braun and Joy.²¹ Their model includes explicit consideration of monetary aspects of the Argentine economy, and the agricultural sector plays a strategic part, not only as the source of Argentina's most important exports, but as the source of the most important wage-goods as well, and thus in the determination of the level of real wages. The mechanics of their model is set out in the context of a hypothetical one hundred percent devaluation. Because foodstuffs are exported as well as consumed domestically, their price is determined by the world price in pesos. Hence the price of foodstuffs within Argentina is doubled. This in itself means a substantial drop in the real wages of workers outside agriculture, if money wages do not rise substantially. Braun and Joy assume that the decline in real wages applies also to workers in agriculture, although there is an increase in money incomes in agriculture (indeed, a virtual doubling). The reason is that the increase in money incomes is

²¹O. Braun and L. Joy, "A Model of Economic Stagnation: A Case Study of the Argentine Economy," Economic Journal, LXXVIII (Dec. 1968), pp. 866-887.

is supposed to go "primarily to landowners and marketing firms."²² The overall result of this decrease in real income, however, is a decrease in the demand for Argentine manufactures and services, the demand for foodstuffs being inelastic with respect to both prices and real incomes. "...in the case of manufactures, variable inputs consist only of homogenous labor and imported inputs combined in fixed proportions, for which the marginal product is constant over the relevant range." "The price of manufactured goods will rise to the extent of the rise in the costs of the imported content."²³ The demand for manufactures will thus be still further restricted. However, the quantity of imported inputs will be reduced as a consequence of this decrease in the demand for manufactures. Investment in manufacturing will also be constrained. This constraint, a result of decreased demand for output, is likely to be reinforced by monetary and to some degree fiscal policy directed against the price inflation resulting from the devaluation. "A fall in total investment will reduce the import bill in respect of the import content of investment."²⁴ Thus external equilibrium comes about, at the expense of a serious recession internally. "The key assumption which generates these results in our model is the assumption that the value of imports exceeds the value of exports at full employment."²⁵ Thus the model of Braun and Joy is a model which assumes

²²Ibid., p. 872.

²³Ibid., p. 869.

²⁴Ibid., p. 870.

²⁵Ibid., p. 890.

a simultaneous constraint of output and investment by imports and aggregate demand, as the last section speculated might be appropriate. Within its narrower scope, the evidence in this chapter is consistent with the hypothesis of Braun and Joy. In the context of Argentina, a test of the more complex model would seem particularly important.

The same is true of Brazil. The evidence for Brazil is equivocal, as noted above, with the model 1 data inconsistent with all hypotheses at the 5% confidence level, and the model 5 data consistent only with the standard hypothesis at that confidence level. However, when the comments of the last section about an identification problem in the case of model 5 estimates are taken into account, the model 5 estimates for Brazil may be seen in a different light. Since the evidence seems, on net, barely more favorable to the Linder-Chenery hypothesis than unfavorable to it (since, prima facie, imports seems to influence investment strongly), more study is clearly needed to resolve the very considerable doubt that remains.

It is of interest that the evidence for a trade constraint is particularly clear in the cases of the "relatively less developed"²⁶ LAFTA countries, Colombia, Ecuador, Peru and Paraguay.

In the cases of Nicaragua and Puerto Rico, some regression estimates were tried which included exports as an independent variable in the case of model 5. However, no improvement in the result was observed.

²⁶ See Ch. 5 above, pp. 126.

IV

While the magnitudes of the parameters must remain doubtful due to the bias resulting from errors of measurement in the independent variables, and possibly from other sources as well, the regressions in which investment was the dependent variable seem to support the hypothesis of a trade constraint in most cases. The evidence is clearest in the cases of Argentina, Colombia, Ecuador, Guatemala, Honduras, and Peru. The evidence is less clear in the cases of Paraguay, Puerto Rico and Brazil, but in those cases there is evidence of a positive relation between imports and investment. In the case of Chile, it would appear that there has been no effective imports constraint on investment in the period under study. In the case of Nicaragua, no conclusion can be drawn. Given the small series of data for Nicaragua, this is hardly surprising. The regressions with gross domestic product as the dependent variable were far less successful, and while this is also to be expected on the arguments of the last chapter, further study seems to be needed as to the role of aggregate demand or other determinants of gross domestic product in a trade-constrained economy.

APPENDIX TO CHAPTER SEVEN

I

THE DATA USED, BY COUNTRY

TABLE 1

THE DATA FOR ARGENTINA
Billions of Pesos at 1960 Prices

Year	Imports	GDP	Investment
1950	93.750	710.329	114.085
1951	105.384	739.165	139.853
1952	77.669	692.066	124.721
1953	63.641	741.088	123.141
1954	83.486	768.962	120.176
1955	100.365	821.829	139.685
1956	89.759	835.285	147.618
1957	100.137	881.423	158.138
1958	104.471	944.863	170.591
1959	92.496	890.074	138.613
1960	114.052	961.203	208.622
1961	135.607	1028.487	245.522
1962	130.247	1009.263	222.561
1963	101.392	973.699	180.386
1964	117.701	1051.556	191.606
1965	116.447	1141.909	198.044
1966	111.885	1136.142	200.860

TABLE 2
THE DATA FOR BRAZIL
Billions of Cruzieros at Prices of 1953

Year	Imports	GDP	Investment
1947	21.7	309.7	34.3
1948	19.9	339.0	34.5
1949	21.9	358.0	39.5
1950	27.3	375.9	47.8
1951	40.2	395.2	63.6
1952	37.2	417.4	67.6
1953	32.4	430.7	55.8
1954	42.3	463.9	69.1
1955	40.0	495.5	61.7
1956	41.1	504.8	66.5
1957	47.3	539.5	74.6
1958	45.8	575.3	79.1
1959	52.3	617.5	87.7
1960	54.8	658.7	94.5
1961	44.8	706.7	103.3
1962	42.7	744.5	101.4
1963	42.9	756.5	103.2
1964	36.0	780.0	93.2
1965	36.5	810.1	74.7
1966	42.1	846.1	92.7

TABLE 3

THE DATA FOR CHILE
Millions of Escudos at Prices of 1960

Year	Imports	GDP	Investment
1950	0343.3	3535.1	356.0
1951	0419.9	3447.5	389.3
1952	0451.8	3833.7	419.1
1953	0439.9	4059.3	426.8
1954	0423.5	4305.1	420.2
1955	0496.8	4452.6	485.6
1956	0508.2	4147.2	422.9
1957	0579.9	4429.9	472.8
1958	0509.9	4656.6	436.2
1959	0517.0	4686.8	461.4
1960	0740.0	4781.0	405.0
1961	0825.5	4861.0	480.4
1962	0761.3	5330.6	495.5
1963	0778.4	5582.3	534.7
1964	0810.9	5816.0	516.0
1965	0840.1	6107.5	539.4
1966	1065.6	6537.8	547.2
1967	1120.6	6670.1	554.2

TABLE 4
THE DATA FOR COLOMBIA
Millions of Pesos at Prices of 1958

Year	Imports	GDP	Investment
1950	3304.7	14688.8	2771.8
1951	3183.8	15146.6	2752.5
1952	3235.3	16102.0	2965.4
1953	4443.4	17081.0	4011.7
1954	4915.7	18262.3	4670.0
1955	5130.7	18976.1	4935.7
1956	4703.6	19745.7	4683.7
1957	4013.7	20186.2	3511.6
1958	3418.7	20682.5	3338.8
1959	3731.3	22128.6	3587.7
1960	4314.5	23041.8	4209.6
1961	4229.5	24179.0	4550.4
1962	4371.0	25396.0	4584.4
1963	4361.9	26238.0	4291.8
1964	5216.3	27812.3	4796.7
1965	4128.1	28701.7	4396.6

TABLE 5

THE DATA FOR ECUADOR
Millions of Sucres at Prices of 1960

Year	Imports	GDP	Investment
1950	1160	08693	0740
1951	1411	08938	0985
1952	1403	09875	0904
1953	1677	10195	1093
1954	2158	11016	1457
1955	2079	11039	1574
1956	2182	12327	1602
1958	2163	12609	1547
1959	2211	13261	1767
1960	2476	14140	1897
1961	2458	14357	1949
1962	2730	15008	1826
1963	2630	15597	1920
1964	2887	16809	2025
1965	3023	17366	2073
1966	2863	18185	2065
1967	3197	19191	2069

TABLE 6

THE DATA FOR GUATEMALA

Millions of Quetzales at Prices of 1958

Year	Imports	GDP	Investments
1950	073.4	0715.5	076.2
1951	088.8	0698.7	077.5
1952	085.1	0748.7	056.8
1953	095.1	0775.3	067.6
1954	102.9	0736.3	074.1
1955	121.6	0809.1	090.4
1956	153.2	0882.7	142.5
1957	167.2	0932.5	154.2
1958	165.1	0970.9	137.1
1959	164.0	1018.1	126.4
1960	165.8	1047.9	109.4
1961	153.9	1088.1	114.2
1962	162.0	1115.6	116.7
1963	205.7	1256.0	130.2
1964	237.8	1340.5	160.8
1965	270.4	1439.2	163.3

TABLE 7

THE DATA FOR HONDURAS
Millions of Lempiras at Prices of 1948

Year	Imports	GDP	Investments
1948	077.3	386.6	042.1
1950	082.3	403.4	046.9
1951	100.0	422.6	056.4
1952	121.7	435.9	073.3
1953	123.0	464.3	081.5
1954	116.9	434.8	060.1
1955	120.2	451.9	065.4
1956	122.6	493.4	066.3
1957	136.6	526.3	073.6
1958	129.8	539.1	066.3
1959	123.4	560.8	063.8
1960	125.0	570.6	067.9
1961	131.0	593.4	062.6
1962	141.2	629.4	081.2
1963	164.6	642.0	091.4
1964	174.6	660.8	090.9
1965	219.1	730.7	102.5
1966	258.4	777.7	119.2
1967	280.8	819.2	136.4

TABLE 8

THE DATA FOR NICARAGUA
Millions of Cordobas at Prices of 1958

Year	Imports	GDP	Investments
1953	0462	1895	306
1955	0534	2211	376
1956	0600	2209	348
1957	0645	2396	346
1958	0665	2404	334
1959	0579	2440	358
1960	0594	2473	331
1961	0646	2633	360
1962	0832	2911	422
1963	0925	3125	522
1964	1127	3387	614
1965	1304	3844	668
1966	1329	3964	753

TABLE 9

THE DATA FOR PARAGUAY
Millions of Guaranies at Prices of 1962

Year	Imports	GDP	Investments
1950	3827	31228	2486
1953	4881	32576	5944
1955	4909	36176	4184
1956	4735	35747	3919
1957	7828	38233	6818
1958	8154	40263	6749
1959	6458	40134	5869
1960	7235	40802	6895
1961	8791	43118	7269
1962	6670	45483	5639
1963	6214	46539	5142
1964	7196	47880	5744
1965	8441	51004	7423
1966	8831	52274	7759
1967	8795	55961	8852

TABLE 10

THE DATA FOR PERU
Millions of Soles at Prices of 1963

Year	Imports	GDP	Investments
1950	6366	38956	7047
1951	7894	43036	9303
1952	8704	44285	10700
1953	9333	45247	11561
1954	8686	49613	9106
1955	11409	52065	10415
1956	12753	54439	13448
1957	14244	54968	14450
1958	12341	56968	12583
1959	10853	58834	09930
1960	12967	64175	10693
1961	15730	69411	13535
1962	17774	75836	15638
1963	19409	78710	15111
1964	20903	84852	15829
1965	25000	88501	20494

TABLE 11

DATA FOR PUERTO RICO
Millions of Dollars at Prices of 1963

Year	Imports	GDP	Investments
1951	0604.3	1193.3	215.7
1952	0678.6	1239.8	225.7
1953	0734.8	1274.3	225.3
1954	0806.3	1329.0	274.8
1955	0857.7	1438.1	266.0
1956	0927.4	1529.4	306.8
1957	0944.1	1604.6	320.1
1958	1039.1	1694.2	341.2
1959	1162.8	1861.7	395.2
1960	1167.3	1998.8	404.0
1961	1389.6	2145.0	468.4
1962	1471.1	2325.1	500.0
1963	1652.6	2548.5	584.0
1964	1805.3	2808.4	700.6
1965	1945.7	3061.3	718.3
1966	2088.2	3231.9	849.4
1967	2244.9	3513.0	889.0

TABLE 12

THE DATA FOR VENEZUELA
 Millions of Bolivares; Prices of 1957
 Except Import Data at Current Prices

Year	Imports	GDP	Investments
1950	2639	12728	3264
1951	2815	14212	3471
1952	3342	15248	4358
1953	3575	16190	4785
1954	3798	17749	5466
1955	4008	19325	5160
1956	4978	21366	5596
1957	6859	23847	5550
1958	6747	24164	5896
1959	6456	26066	6066
1960	4882	26643	4725
1961	5017	27156	4019
1962	5663	28736	4196
1963	5396	29818	4307
1964	7122	32326	5178
1965	7940	34019	5611
1966	7691	34786	5682

II. SIMPLE CORRELATION COEFFICIENTS, BY COUNTY

TABLE 13

ARGENTINA

CORRELATION COEFFICIENTS				
	t	M	GDP	I
t	1.00000			
M	0.66597	1.00000		
GDP	0.97393	0.75632	1.00000	
I	0.81415	0.88655	0.85959	1.00000

TABLE 14

BRAZIL

CORRELATION COEFFICIENTS				
	t	M	GDP	I
t	1.00000			
M	0.64800	1.00000		
GDP	0.99276	0.58811	1.00000	
I	0.89230	0.80909	0.88250	1.00000

TABLE 15

CHILE

CORRELATION COEFFICIENTS				
	t	M	GDP	I
t	1.00000			
M	0.94197	1.00000		
GDP	0.97039	0.94065	1.00000	
I	0.88950	0.84342	0.91707	1.00000

TABLE 16

COLOMBIA

CORRELATION COEFFICIENTS				
	t	M	GDP	I
t	1.00000			
M	0.40812	1.00000		
GDP	0.99541	0.43992	1.00000	
I	0.58930	0.93453	0.61247	1.00000

TABLE 17

ECUADOR

CORRELATION COEFFICIENTS				
	t	M	GDP	I
t	1.00000			
M	0.93616	1.00000		
GDP	0.97005	0.96198	1.00000	
I	0.79116	0.89864	0.79611	1.00000

TABLE 18

GUATEMALA

CORRELATION COEFFICIENTS				
	t	M	GDP	I
t	1.00000			
M	0.93616	1.00000		
GDP	0.97005	0.96198	1.00000	
I	0.79116	0.89864	0.79611	1.00000

TABLE 19

HONDURAS

CORRELATION COEFFICIENTS				
	t	M	GDP	I
t	1.00000			
M	0.85776	1.00000		
GDP	0.97015	0.93384	1.00000	
I	0.82460	0.97211	0.89844	1.00000

TABLE 20

NICARAGUA

CORRELATION COEFFICIENTS				
	t	M	GDP	I
t	1.00000			
M	0.89483	1.00000		
GDP	0.84486	0.97606	1.00000	
I	0.91614	0.97053	0.96440	1.00000

TABLE 21

PARAGUAY

CORRELATION COEFFICIENTS				
	t	M	GDP	I
t	1.00000			
M	0.79435	1.00000		
GDP	0.98041	0.77817	1.00000	
I	0.73684	0.91701	0.72569	1.00000

TABLE 22

PERU

CORRELATION COEFFICIENTS				
	t	M	GDP	I
t	1.00000			
M	0.93218	1.00000		
GDP	0.97805	0.96839	1.00000	
I	0.80130	0.93968	0.85161	1.00000

TABLE 23
PUERTO RICO

CORRELATION COEFFICIENTS				
	t	M	GDP	I
t	1.00000			
M	0.97778	1.00000		
GDP	0.87152	0.99768	1.00000	
I	0.75437	0.99297	0.99463	1.00000

TABLE 24
VENEZUELA

CORRELATION COEFFICIENTS				
	t	M	GDP	I
t	1.00000			
M	0.85853	1.00000		
GDP	0.99615	0.89386	1.00000	
I	0.35404	0.68057	0.40280	1.00000

CHAPTER 8

A SUGGESTION FOR FURTHER RESEARCH

Throughout this paper it has been assumed, following most of the two-gap theorists, that aggregate demand relationships are of little or no importance to a trade-constrained economy.¹ However, that is not necessarily true. This point will be explicitly considered in this chapter.

It was pointed out in the last chapter that the difficulties of estimating relationships with product as the dependent variable might result from aggregate demand relationships. Such relationships were not explicitly considered in either model 5) or 6). There is an alternative explanation also, as noted there.² To estimate a model embodying aggregate-demand relationships, and thus

¹See e.g., S. Linder, Trade and Trade Policy for Development (New York: Praeger, 1967), p. 20, pp. 65-66. Linder's calculations of frustrated savings assume the propensity to save is purely passive; to the extent that this is not so, they are understated; i.e. insofar as output is limited by aggregate demand, the extent to which actual output falls short of potential output times the actual saving propensity is a wastage of saving capacity over and above the wastage implied by a reduction in the propensity to save.

Nelson ("The Effective Exchange Rate: Employment and Growth in a Foreign-Exchange Constrained Economy," Journal of Political Economy, LXXVIII, 3, (May-June 1970) pp. 546-564) also takes issue with the assumed absence of aggregate demand relationships.

²See above, p. 169.

resolve the question raised in the last chapter, would require a simultaneous-equations model, estimation of which is beyond the scope of this paper.

In a trade-constrained economy, we have

$$1. \quad M = M_k + M_c$$

$$2. \quad M_k \geq aI, \quad a \leq 1,$$

$$3. \quad M_c \geq bY + g, \quad b \leq 1,$$

where a , b , and g are constants. The aggregate demand relationships give us, in addition,

$$4. \quad Y = C + I + G + E - M,$$

where, as usual, C is consumption, G net government expenditure, and E exports. All other variables are as in the last chapter. The consumption relation may be interpreted as a constraint:

$$5. \quad C \leq C_0 + cY$$

where c is a constant and C_0 is autonomous consumption. Finally, for present purposes,

$$6. \quad G = \bar{G},$$

$$7. \quad E = \bar{E},$$

i.e., net government expenditure and exports are treated as exogenous variables.

To derive the multiplier relationship in this case, it is necessary first to separate imports into its components. From 1,2,3. above,

$$8. \quad M = M_k + M_c \geq aI + bY + g;$$

hence,

$$9. \quad Y \leq C + I + G + E - aI - bY - g,$$

and the multiplier relationship becomes an inequality:

$$10. \quad Y \leq \frac{1}{1-c+b}(C_0 - g + (1-a)I + G + E).$$

A constraint upon income is also directly implied by 1, 2, 3. It is

$$11. \quad Y \leq \frac{1}{b}M - \frac{a}{b}I - \frac{g}{b}.$$

The relationship of the two inequalities may be as given in Figure One. With a given (and sufficiently low) capacity to import, there is no level of investment which would make the aggregate demand constraint effective. This will be called case 1. Another case is possible, as in Figure Two. In Figure Two, a level of investment below I_0 will make the aggregate demand constraint effective, and the imports constraint ineffective. This will be case 2-a. A level of investment of exactly I_0 will make both constraints effective simultaneously. This will be case 2-b. Finally, a level of investment above I_0 will make the aggregate demand constraint ineffective. This will be case 2-c. Clearly, in either case 1 or case 2-c, there is no need to be concerned about the influence of aggregate demand on any of the variables. In particular, the actual level of income and product will be determined otherwise than by aggregate demand. In case 1-a, the imports constraint is irrelevant, because it is ineffective. Only in case 1-b would both aggregate demand considerations and import-constraint considerations bear simultaneously on the determination of income, investment and consumption. However, it is not clear prima facie, what forces if any, would cause the level of investment to tend toward I_0 . It is possible to speculate about forces of two kinds: market forces and government

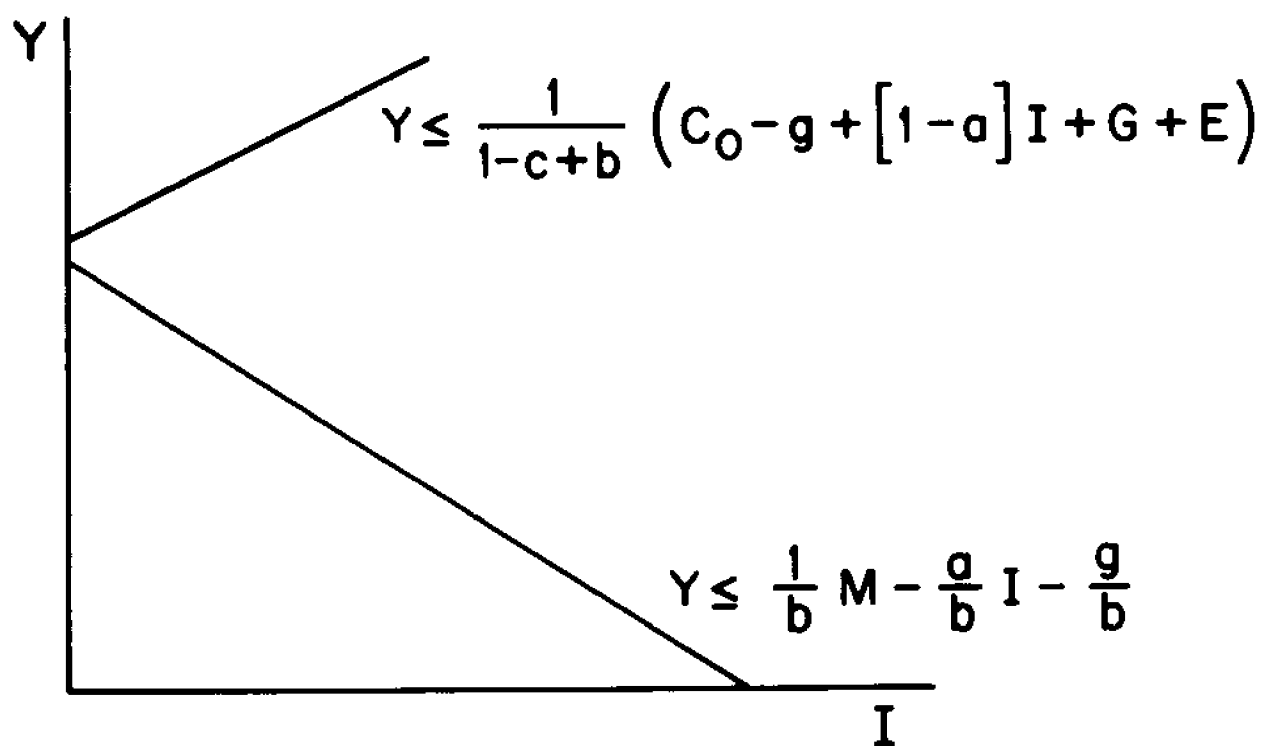


Figure 1

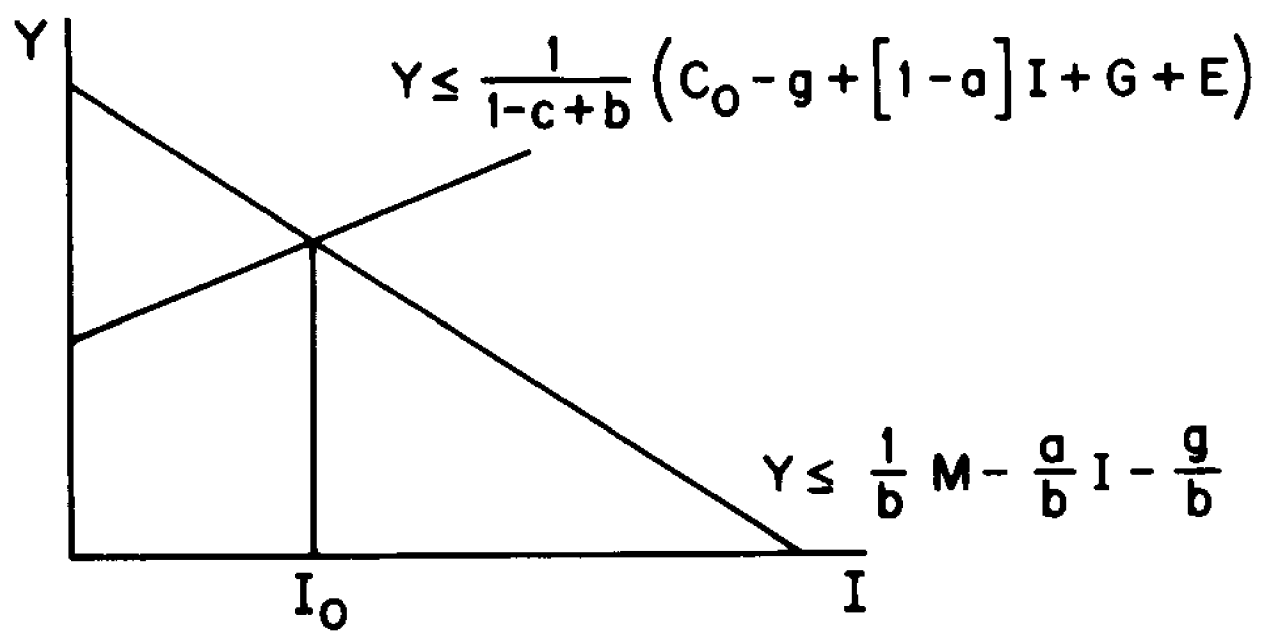


Figure 2

intervention.

First, consider the possible influences of market forces. In the Keynesian context, investment is determined by the marginal efficiency of investment together with the interest rate.³ It might be that the marginal efficiency of investment would drop quite steeply in the neighborhood of I_0 , since below I_0 , imported capital goods would be relatively cheap or readily available or both, while above I_0 they would be very scarce, and the price would be very high. If so, then investment would approximate I_0 for a large range of interest rates, through market forces.

Second, consider the motives of government intervention. The effective portions of the two constraints (which are, of course, the lower portions) can be considered as an investment-current output possibility frontier. If the planners' time preference⁴ is relatively

³The General Theory of Employment, Interest, and Money, (New York: Harcourt, Brace and World Harbinger Books, 1964), pp. 135-6. Keynes' term is the marginal efficiency of capital; the term used here follows B. Horvat ("The Rule of Accumulation in a Planned Economy," Kyklos, XXI (1968) Fasc. 2, p. 243). Horvat cites A. Lerner ("Recent Developments in Capital Theory," mimeographed, 1965) for a parallel distinction; broadly speaking the MEI reflects the influence of the rate of investment while the MEC reflects the influence of the stock of capital. This is a complex matter and it is beyond the scope of this chapter to enter into it; the purpose of the reference to the marginal efficiency of investment is, in any case, illustrative. See, for example, A. Leijonhufvud, Keynesian Economics and the Economics of Keynes, p. 33n, p. 136, p. 278, and other places (New York: Oxford University Press, 1968).

⁴This term is adapted from J. Drewnowski, "The Economic Theory of Socialism: A Suggestion for a Reconsideration," Journal of Political Economy, LXIX, 4 (Aug. 1961), pp. 341-54; republished in M. Bornstein, Comparative Economic Systems: Models and Cases (Homewood, Ill.: Irwin, 1965), pp. 117-134.

strong, then it would seem likely that they would choose the maximum level of current income, which corresponds in fact to I_0 .

Thus, in case 1) the capacity to import is large enough to make the aggregate demand constraints effective for positive investment, and 2) market forces, government intervention, or the two together tend to bring the level of investment to I_0 , then case 2-b will prevail and both aggregate demand and import-constraint forces must be considered. This relatively naive, static Keynesian model is meant primarily to illustrate the kinds of considerations which would come into play. Certainly much can be done to improve the model. For example, an explicit distinction ought to be made between disposable income and gross domestic product in the determination of the aggregate demand constraint. Variables of a more "classical" kind could also be brought within the analysis.

In developing this hypothesis, of course, the most useful studies would be empirical studies in an explicit simultaneous-equations form which could identify the parameters of the import-constraint-and-aggregate-demand model or reject it as invalid. As the last chapter pointed out, although the equations with investment as the dependent variable would be identified in the single-equation approach of this paper, the equations with product as the dependent variable could not be identified. It is impossible to say whether relation 10. or 11. was being estimated. However, in case 2-b, relations 2, 3, and 5 are all strict equalities. If an eighth equation is added to the first seven, expressing the given character of the capacity to import, then the system is just

determined, there being eight independent, consistent equations in the eight variables M , M_k , M_c , I , Y , C , G , and E .

As noted in the last chapter, even if the identification problem is resolved, estimation problems remain, as the ordinary least squares estimates are biased and inconsistent.⁵ Presumably another method would be preferable, such as indirect or two-stage least squares.⁶

In summary, the estimates reported in the last chapter are mostly consistent with the hypothesis that an effective trade constraint exists in the Latin American countries studied, but they leave the mode of its operation in doubt. Further study might resolve that doubt. Such study surely is desirable in the light of the hypothesis sketched in this chapter. Moreover, if the simultaneous-equations model is the correct one, then the estimates given here are biased, and such studies might refine (and conceivably might reverse) the conclusions drawn.

⁵D. Huang, Regression and Econometric Methods (New York: Wiley, 1970), p. 209.

⁶Ibid., pp. 225-32.

CHAPTER 9

SUMMARY

This paper has been a study of the growth of an economy subject to a foreign-trade constraint, with particular attention to the implications for the Latin American countries. Part One centered on the theory and the policy conclusions with respect to economic integration among underdeveloped countries. Part Two has attempted to test the proposition that the capacity to import has been a constraint upon investment and production in the cases of eleven Latin American countries and in the case of the Commonwealth of Puerto Rico.

It has been argued that some underdeveloped countries suffer from chronic balance-of-payments problems because of their dependence on imports for certain input goods. This being the case, they may be unable to attain internal and external balance simultaneously. At or near full employment the requirements of imported raw and semifinished materials, or other irreducible consumption import needs, together with the required imported capital goods for the level of investment corresponding to full employment, will be greater than the capacity of the country to import. The country may be unable to expand its export revenue (and thus its capacity to import for any of the following reasons: 1) limited

demand and limited elasticity of demand for traditional export goods, 2) inability to add novel exports on account of the comparative disadvantage in these areas deriving from the absence of "representative demand" for them,¹ 3) inability to add novel exports because of the comparative disadvantage (in products which themselves require large quantities of technologically intensive import inputs²), and 4) inability to add novel exports because of protection in the countries to which exports might go, especially the developed countries. Thus, either they will experience a balance-of-payments deficit or unemployment, reduced investment and slowed growth. Of course, in all likelihood import substitution can alleviate the problem, over time. Other forces may tend to increase it, over time.

Depending upon the elasticity of demand for exports, rate of increase of the demand for exports, the parameters of the production function of exports, and the rate of growth of the country's domestic production, the "trade gap" may emerge as a "necessary and endemic result of the development process."³ In the case of primary production, there is some reason to believe that the characteristics of the production functions would be particularly unfavorable.

If economies of scale are important in the relevant range,

¹S. B. Linder, Trade and Trade Policy for Development, (New York: Praeger, 1967), pp. 36-38.

²See above pp. 63-64.

³H. Bruton, "The Two-Gap Approach to Aid and Development," American Economic Review, LIX, 3 (June, 1969), p. 446.

integration of the national economies of underdeveloped countries can facilitate import substitution and in this way promote growth and balance. However, unless explicit measures are taken to prevent it, internal trade gaps can occur and produce economic stresses which are likely to disrupt programs of economic integration. It is particularly important to "harmonize" industrialization plans.

It appears from the empirical study that, in a majority of the cases, imports have been an important constraint of investment, while only one country presents evidence to the contrary. However, there is some evidence that constraints other than imports have been important determinants of production. The data were not very satisfactory, and there is some evidence that bias due to errors in the data influenced the results, though quite likely in a direction unfavorable to the "two-gap" hypothesis.

Both in theory and in the empirical study, it appears that the importation of capital goods plays a critical role in the "trade gap." It may be that development will, in the long run, require self-sufficiency or something approaching self-sufficiency in the production of capital goods.

In conclusion, the role of imports as a constraint of investment seems to play an important part in the development of some, and perhaps almost all, Latin American Countries.

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VITA

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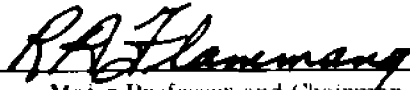
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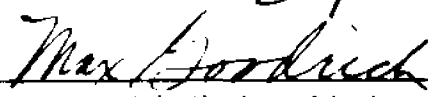
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Major Field: Economics


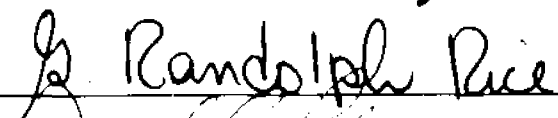
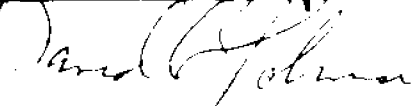
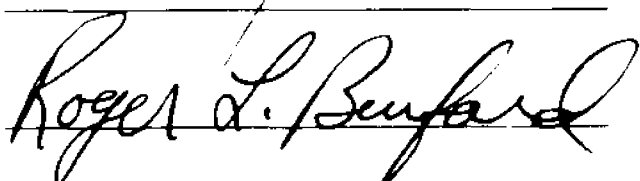
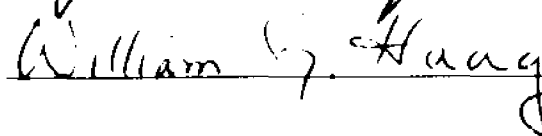
Title of Thesis: The Trade Gap in Latin America: The Theory of the Growth of the Foreign Trade Constrained Economy and a Test of Its Relevance to Latin America

Approved:


Major Professor and Chairman


Dean of the Graduate School

EXAMINING COMMITTEE:

Date of Examination:

March 25, 1971